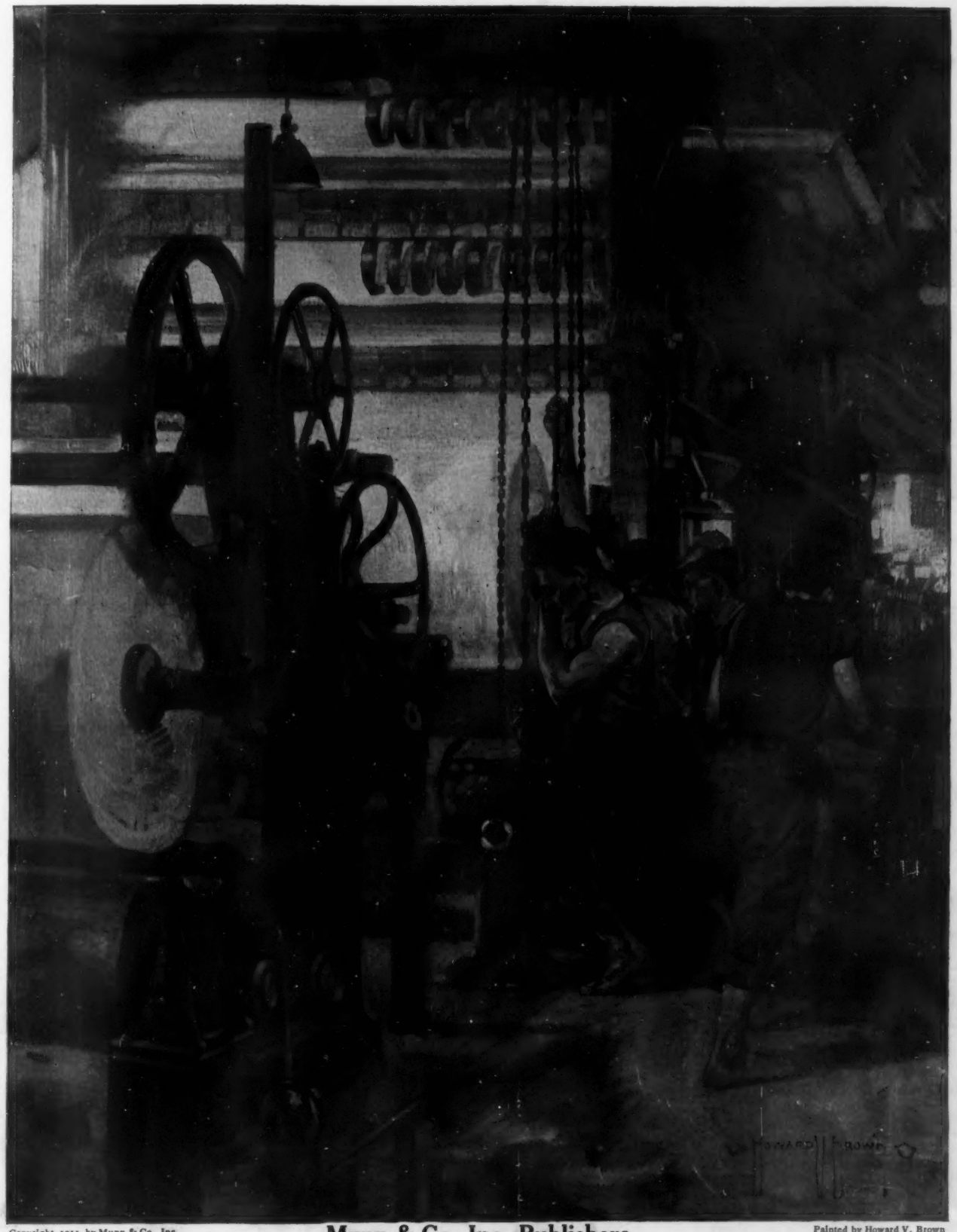
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION



Vol. CIX. No. 14
October 4, 1913

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Painted by Howard V. Brown

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Efficiency's First Aid —Good Light

"You're working in the dark!" said a Western plant manager to his friend who had asked him to visit the latter's publishing offices in an Eastern Ohio town. "How do you make that out?" asked the publishing man with a little astonishment. "We've had electricity here for five years."

"That may be," said the Western man. "And I don't mean that you can't see your hand before your face. But you haven't really emerged from the dark age. Honest, have you changed your lighting arrangement in these five years?"

The publishing man admitted that he hadn't.

"I thought so," said his frank visitor. "They were pretty poor to begin with, and they're entirely out of date. They're out of date because we're living in an age of really good light. More than half of your floor space is gloomy, partly because you use old-fashioned lamps—the Edison Mazda gives three times as much light with the same amount of electricity that is used in these ordinary carbon lamps—and partly because they are not placed to advantage. You're handicapping yourself and your entire force. You're putting a check on your office efficiency, which is bad business, and you're wasting money on old methods which is bad business again. Good light is a big factor—it's efficiency's first aid. It would be worth all it costs even if it cost a lot of money. And yet it's cheaper than ever it was—been going down in price while the cost of everything else has been going up."

The result of this plain talk was that the publishing man got into communication with the local lighting company next day and found himself keenly interested in the plans laid out by the electrical engineer who called to see him. Seven months later when he saw his friend again he declared: "You put it bluntly about my lighting, but you saved me money. My system now costs me no more, and you wouldn't know the place as it is now. It has put snap into all our work—I think we turn out fully thirty per cent. more than we did, and we do it with fully fifty per cent. more comfort. I'm a light enthusiast from now on."

This incident reflects an experience in a certain type of business, but there is no sort of business to which the outspoken philosophy that stirred this particular manager might not apply with equal force. For manufacturer and merchant, banker, broker or business man anywhere, good light is a basic business factor.

Good light is good business. It brings people into a store, for example, and helps sell goods to those people. It helps the display of goods, and if affects not only customers but the selling force.

It affects equally the brain output and the physical output of every sort of business. It raises the percentage of sheer efficiency in every unit of a force, whether it is a small office force of a dozen or a large force of a thousand. That percentage of increase in efficiency would be considered highly important in a group of machines. It is even more so in a group of men or women.

Perhaps you have realized this fact in your business without guessing exactly how the thing might be worked out to meet your special needs and opportunities. It is possible that you have not ascertained the cheapness and facility of modern wiring—that you may not know of the growing cheapness of electric light itself.

These are matters which an electrical engineer knows, and can lay before you.

The electrical expert will tell you about the Edison Mazda lamp. He will show you the comfort—for you personally and for your force—and—he will show you the real economy that lies in modern ways of lighting.

Take up the matter today with your electric power and light company, or any General Electric Company agent in your vicinity. You will find them more than glad to co-operate with you, and no matter how complex your problem may be, they have at their command the service of any part of our organization that may be most helpful to them and to you.

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4191

SIXTY-NINTH YEAR

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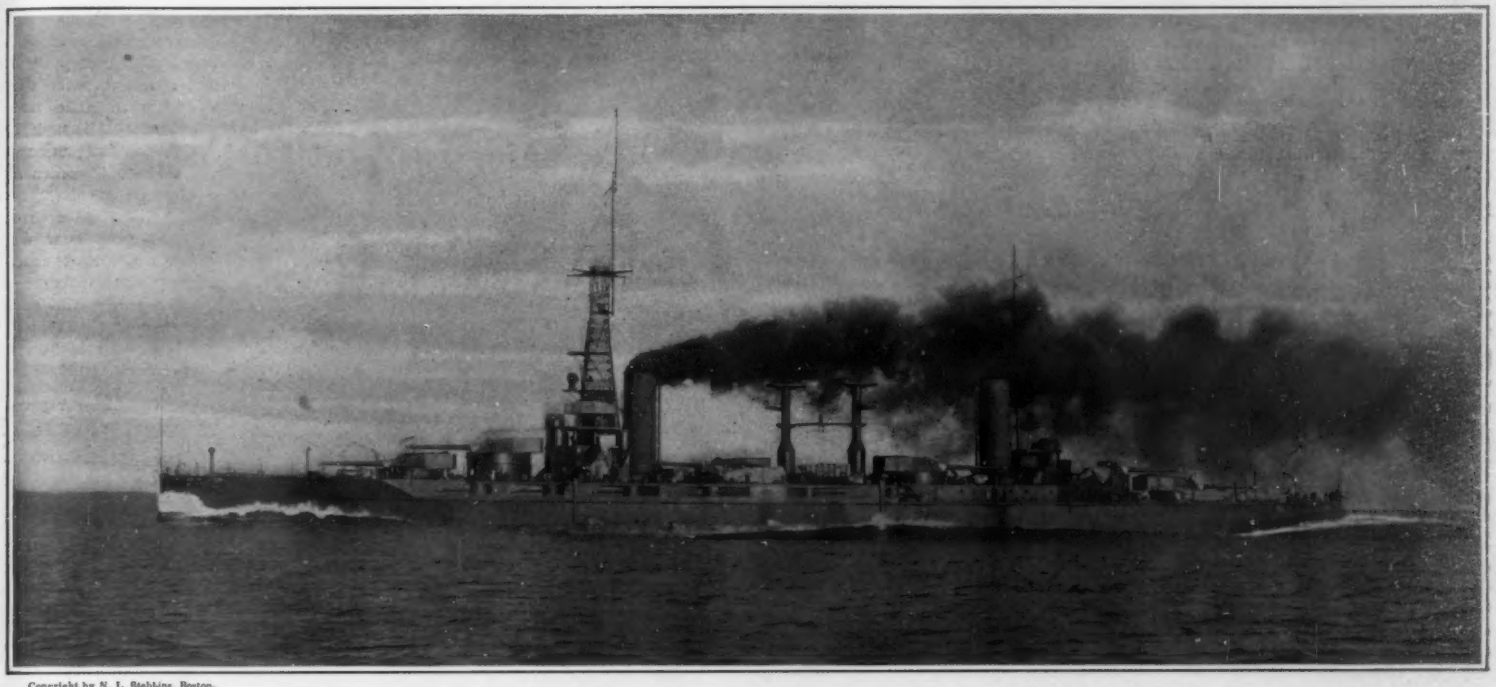

Length, 585 feet. **Beam,** 98 feet. **Full Load Displacement,** 30,600 tons. **Horse-power,** 40,000. **Speed,** 22.5 knots. **Armor:** Belt, 12-inch; upper belt, 9-inch to 6-inch; turrets, 12-inch; deck, 3-inch. **Armament:** Twelve 12-inch, twelve 6-inch, sixteen 4-inch. **Torpedo tubes,** two 21-inch. **Maximum fuel capacity,** coal, 4,000 tons; oil, 600 tons. **Complement,** 1,050 men.

The 27,600-ton Argentine dreadnought "Rivadavia" making 22.50 knots on her trials.

The New Argentine Dreadnought "Rivadavia"

The First Dreadnought to be Built in American Yards for a Foreign Power

THERE is a decided prestige attaching to records for high speed which renders the recent speed trials of the "Rivadavia" very gratifying to the builders and owners of that ship. The "Rivadavia" and her sister the "Moreno" are two dreadnoughts of the largest size and power, for which, a few years ago, the Argentine government solicited bids from the leading shipyards of the world. There was very spirited competition to secure this contract, and it was a matter of great satisfaction when an American company, the Fore River Ship and Engine Building Company of Quincy, Mass., secured the contract for both ships at a price of $22,000,000. One of these, the "Rivadavia," was laid down at Quincy; the other was sublet to the New York Shipbuilding Company, Camden, New Jersey.

The "Rivadavia" underwent her high speed trials on September 16th, when she slightly exceeded her contract requirement of 22.5 knots an hour, the displacement of the ship at the time being 27,666 tons, and the average horse-power developed being 40,000. The "Rivadavia" is thus the fastest battleship yet built in America. Of the dreadnoughts built for our Navy the "Delaware" made 21.56 knots; the "Utah," 21.01 knots; the "North Dakota," 21.01 knots; and the "New York" and the "Texas" made 21 knots.

As will be seen from our illustration, the "Rivadavia" differs considerably in her outboard profile from the ships of the United States Navy. She has only one lattice mast carrying a fire-control platform, the mainmast being of the older type. The boiler rooms are spaced wide apart, the forward smokestack being immediately behind the foremast, and the after stack immediately in front of the mainmast. The two cranes are placed diagonally amidships and connected by a flying bridge. Another noticeable difference from our ships is that the forecastle deck is continued aft for three quarters of the length of the ship, terminating abaft the mainmast.

The powerful main battery, consisting of twelve 50-caliber, 12-inch guns, is equal in power to that of our "Wyoming" and "Texas," which also carry twelve 12-inch guns; but the distribution is different. On the forecastle deck are two turrets, the after one with its guns superposed above the forward turret, and amidships, between the smokestacks, are two more turrets placed *en echelon*, and so arranged that the four guns of these turrets can be fired dead ahead, dead astern, or over a restricted arc on either beam. The other two turrets are placed astern of the mainmast, one at the after end of the superstructure, and the other on the quarter deck. This arrangement provides for a fire dead ahead or dead astern of eight guns, while the whole battery of twelve guns may be fired on each broadside.

The armor distribution is as follows: The main belt, 12 inches in thickness, extends for 250 feet amidships; it tapers from that thickness to 5 inches at the bow and 4 inches at the stern. This belt is 9¾ feet wide and 5 feet of it extends below the mean waterline. Above this belt is a secondary belt which varies from 9 inches in thickness at its junction with the main belt to 6 inches abreast of the 6-inch gun battery. This battery is located between number 1 and number 5 turrets, there being six guns on each broadside. It should be mentioned that the "Rivadavia" carries also sixteen 4-inch guns.

Special attention has been paid to the protection of the ship against underwater damage. She carries torpedo nets, and, as an internal protection against torpedoes, she is provided with a 2-inch interior wall of special steel, and also a 1½-inch deck which is worked amidships over the double bottom. The ship has a cruising radius of 7,000 miles at 15 knots and 11,000 miles at 11 knots—certainly a most excellent provision.

Garros' Flight Across the Mediterranean

ON September 23rd Roland G. Garros, the famous French aviator, made what may well be regarded as the most perilous over-sea aerial voyage in an aeroplane thus far achieved. He flew across the Mediterranean Sea from San Raphael, France, to Bizerta, Tunis, a distance of 485 miles. This is the longest over-water flight ever made in an aeroplane. The distance was covered in seven hours and fifty-three minutes at an average speed of 61.44 miles an hour.

This is not the first time that Garros has crossed the Mediterranean. In 1912 he crossed that Sea between Tunis and Sicily—a distance of only 160 miles. That performance was much applauded at the time. His new achievement is all the more remarkable because he did not accept the use of torpedo boats to pick him up in case of an accident.

Artificial Meat

ACCORDING to the Paris daily journals a Belgian scientist, M. Effront, has succeeded in producing artificial meat, and this is another advance made by modern chemistry, after the synthesis of vegetable extracts or perfumes and even the albumens which are the base of living substance. M. Effront now uses a remarkable process for industrial preparation of nitrogenous foods at a very low price, and these are said to resemble ordinary meat in a striking degree. He uses different residues of manufactures which are almost worthless, such as brewery or distillery refuse products, and from these he extracts a food albumen. The refuse material is first washed, then pressed and treated by sulphuric acid and afterward by lime, being then put through other operations which are too long to enumerate, ending by filtering and evaporating *in vacuo*. The result is a pastry extract which has a very pronounced taste of meat and has three times the food value of the latter, owing to its concentrated state. At Brussels several doctors have already made experiments upon nutrition of the human body, and the results are quite conclusive. The same chemist produces a like food by the use of fodder, such as hay or clover as the raw material, and this product has a similar nutritive value as has been proved by various tests. Such researches are as yet far from the absolute synthesis which Berthelot predicted, but economists already forsee that the practical use of these nitrogenous products may go far to counteract the continual rise in prices of food at the present time. Perhaps the day is not distant when science will be able to produce from the mineral world not only foods of animal origin, but those which come from the vegetable kingdom. We expect to give a more detailed account of the process, which appears to be a remarkable one.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

"Sea-level Canal Fallacies"

WE direct attention to the letter from a member of the Institute of Civil Engineers of Great Britain which is published in the correspondence columns of this issue. The writer takes objection to our recent editorial on "Sea-level Canal Fallacies;" and it is evident that he represents the school of English and Continental engineers which believes, or did believe, that whatever might have been its great cost and the added number of years necessary for its completion, a sea-level canal would have been the only satisfactory solution of the problem.

Speaking broadly and as the result of a close personal inspection of conditions during a visit to the canal, we do not hesitate to say that the persistence of foreign engineers in their belief that a sea-level canal is possible at Panama, is due entirely to lack of information, or of appreciation of the actual conditions at the Isthmus. Engineers should hesitate to make broad generalizations regarding huge physical undertakings such as this; for they of all men have reason to know that controlling local conditions may render such generalizations worthless. If our correspondent had stood with the writer at the bottom of the Culebra cut and seen some sixty acres of the mountain sliding into the cut on one side, and seventy acres on the opposite side, at the point of deepest excavation, he would have realized at once that here was a problem requiring separate consideration—one to which broad generalizations should never be applied.

We are still of the opinion that the tidal flow in a sea-level canal would induce an objectionable current; and we cannot understand how the large volume of the Gatun Lake has a bearing upon a question of locks or no locks; since the creation of a high-level lake necessarily implies the construction of locks to render it accessible.

Regarding the question of earthquakes and their effect upon the canal structures, in the near future we shall publish an article by the geologist of the Isthmian Canal Commission which most effectually removes any grounds for anxiety as to the permanence of the canal.

That the 1,000-foot locks will prove too small for vessels that will seek to pass through the canal, we do not believe. We are firmly of the opinion that the demand for greater locks will not come within the "lifetime of the youngest child that can read the SCIENTIFIC AMERICAN." The 900-foot ships of to-day are built of that great length to meet special passenger requirements, which are to be found only on the transatlantic route. But if the day should come when passenger travel between the two oceans warrants the construction of ships of from one thousand to fifteen hundred feet in length, "M. I. C. E." if he has any knowledge of the topography of the Isthmus, must know that it is not beyond the resources of engineering to construct in the low foothills adjacent to the existing locks, other locks of larger size, and to construct them in the dry, and so protected by dikes at either end of the excavation, that they can be thrown into service without one hour's interference with canal traffic.

The "decree of Nature" that there shall be no sea-level canal at Panama is clearly written in the unstable character of the materials through which the canal is being cut, and it is eloquently recorded in the steadily increasing estimates of excavation quantities, sent out in the reports of the engineers. We invite our correspondent's attention to the issue of the *Canal Record* of August 20th, 1913, in which the cold statistics of the engineers tell the story of the problem at Culebra in most convicing fashion. On July 1st, 1912, the estimate of the total amount of excavation for the completed canal was 212,227,000 cubic yards. Eight months later, in February, 1913, the estimate had gone up to 218,138,000, an increase of 5,911,000 cubic yards; and four months later, on July 1st, 1913, there was a further increase of over 14,215,000 cubic yards, the total increase during the year being over 20,000,000 cubic yards, and of this about 9,000,000 yards was due to slides and breaks in the Culebra cut.

We invite attention to the fact that this increase of 9,000,000 cubic yards was due to a few feet lowering of the excavation in the cut to finish it down to grade, 85 feet above the bottom of a sea-level canal. We leave it to our correspondent's imagination to foretell what the increase due to slides alone would be if the cut were carried down eighty-five feet farther.

And let it not be forgotten that the angle of repose—the slope—determined by Nature, is one to seven. What a further vertical excavation of 85 feet would add to the excavation totals on such a slope nobody can understand better than M. I. C. E. himself. Furthermore, it is very doubtful if admission of water to the prism would help to preserve equilibrium. As a matter of fact, the resulting saturation of the toe of the slopes would rather tend to promote further movement.

We are still of the opinion that the time of construction and the total ultimate cost of a canal at sea level would possibly be double that of the present canal.

Already, without adding one foot to the proposed depth of the excavation, the total yardage is about one third greater than that of the original estimate. True, some of this is due to an enlargement of the canal dimensions; but the bulk of it is due to slides. A cut 85 feet deeper throughout, would destroy the equilibrium in many miles of the route where at present no excavation has been made. If we add to the cost of the increase in excavation due to the deeper cut, the interest and depreciation charges, and the great loss in tolls due to the delayed opening of the canal, it will be seen that our estimate of time and cost for construction of the canal at sea level is at least within the bounds of probability.

Apportioning the Responsibility for the New Haven Wreck

THE Interstate Commerce Commission, in its report just issued on the New Haven wreck, seizes the opportunity to press home the all-important fact, recently commented upon by this journal, that the safety of the traveling public is dependent upon the earnest co-operation of the whole personnel of a railroad, from the Board of Directors down to the humblest employee. It was not necessary for Commissioner MacCord to offer even the faintly suggested apology of his report for giving this wreck "a less narrow treatment . . .than that followed in mere inquests or in the ordinary official investigation of a train accident." Such treatment was warranted by the fact that the Commission has heretofore expressed in strong terms its condemnation of the management of this railroad, when it has been called upon to investigate the rapidly-succeeding series of fatal accidents that have taken place within the last few years.

In proof of its contention that the fundamental cause of the dangers of travel on the New Haven Railroad is to be found in the lax system of management, the report shows that, although the directors, after the Westport wreck of 1912 had duplicated the conditions which brought about the Bridgeport wreck of 1911, voted that the president "should make the most searching investigation into the competency of engineers employed by the road," and "that nothing be left undone which will conduce to greater safety in the operation of the railroad," the president was never called upon apparently, nor was any other official of the railroad, to present to the directors any results of such investigations as had been authorized. "The directors," says the Commission, "assume to dispose of their whole responsibility on this subject by a vote depositing it in bulk upon the president, and thereafter as far as appears from the records, made no further inquiry and took no further action, although in quick succession these disasters continued."

The president, general manager and superintendent forthwith issued orders that all the rules should be obeyed, etc., but no intelligent system was devised by which to ascertain when rules were disobeyed. They were disobeyed largely, and only a small proportion of these violations were reported to officials. "Rules were inefficient," says the Commission, "a fault of the high official. Rules were inadequately enforced, the blame for which must be charged to the officials, and while all this was true, high speed was required. And this high speed was required over the section of road where this accident occurred, on which there were in use antiquated signals which were condemned by the locomotive enginemen as well as by the Public Service Commission of Connecticut. There was an imperative call, arising from the density of traffic and complex operating conditions, for close and intensive superintendence. This call was unanswered until after the public hearings in this case."

Having placed the predisposing cause of this run of disasters upon the shoulders of the directorate, the president and the higher officials, the Commission points out that the direct cause of the disaster was the failure of the members of the train crew to obey the rules and exercise the proper degree of caution. The block system was wholly inadequate—the banjo signals exhibiting merely a change of color and not a change of position, and the blocks having no distant signal to make sure of a proper spacing between the trains. The train dispatcher comes in for heavy censure. Although he knew there was a heavy fog, he permitted five passenger trains, running at speeds of from 30 to 51 miles an hour, to be bunched within a distance of about ten miles, with only seven signals properly to space them. One official testified that twenty miles an hour was the maximum safe speed allowable under such conditions of fog, yet no specific orders to this effect had been given to the engineers. Consequently, the engineers seem to have run these closely-bunched trains, carrying their priceless freight of passengers, at any speed they pleased, regardless of the fact that they could not see the signals until they were close upon them. Signals were overrun; the flagman was called in before he could place his warning signal; the conductor appeared to be ignorant of or at least indifferent to the gravity of the situation; and, in fact, the situation was such that any impartial observer will agree with the Commission that "under such circumstances it is not to be wondered at that an accident such as this occurred. It is remarkable only that accidents of this character have not occurred on this line with greater frequency."

The Small Tractor

WHEN the "Imperator" steamed up the Hudson River on one of her recent trips, she carried some five thousand people. Big as she is, by far the biggest machine thus far devised for conveying humanity across the ocean, her efficiency is limited. It took a dozen or more small tugboats to push and pull her into her berth so that the thousands on her decks could complete their journey. Every day the "Twentieth Century Limited" hurries business men from New York to Chicago and from Chicago to New York; but a small army of trucks, taxicabs, street cars, and carriages is required to transport each passenger to and from the train.

Running a farm is not unlike running the "Imperator" or the "Twentieth Century Limited." While engines are employed in increasing numbers to take the place of draft animals, very large power units are required. The rooting up of trees, the deep plowing of the ground, the threshing of the grain, the multitude of operations that must be performed on a large farm, all consume power in abundance. But there are also little tasks that must be done, tasks which cannot be performed by one big machine economically. The ordinary farm tractor will haul an eight-gang plow or a retinue of cultivating implements very cheaply and efficiently. But when corn or potatoes are to be cultivated, power of a very different sort must be called into requisition.

All the mechanical brains of Europe and America have not as yet developed a machine which will do all kinds of farm work economically and efficiently. The Germans have designed machines which perform more feats than lie within the possibilities of a single American tractor. Their farms are cultivated on the intensive principle, and as a result the problem of introducing mechanical power is much more difficult with them than it is with us. Yet out of fifty different models of small tractors which have been developed in France and Germany, there is but one really commercial machine, and that is of German manufacture. The commercial success of that solitary machine depends entirely on its ability to plow. It cannot run a thresher; it cannot even back up. Yet nearly seven hundred machines of this type have been sold up to date.

Twenty tractors are built in America for each plow made in Europe, and each American tractor can do a dozen kinds of work unknown to the power farmer of Europe. Yet power requirements on the farm are so varied, that we cannot expect everything to be done with one machine. Some day farm work will be standardized so that all the light work, including that which is done at present by stationary engines, can be accomplished with one tractor, while another and much larger engine does the heavy work.

Engineering

Excellent Sanitary Record at Panama.—The report of Col. Gorgas for the month of July, 1913, shows a lower death rate than for any of the ten years during which the canal has been under construction. The total death rate per thousand for July was 7.66, and of these only 5.38 were due to disease. These figures may be compared with the death rate per thousand for 1906, which for the month of July was 64.71, of which the death rate due to disease was 62.15.

Expert Report on New Haven Wreck.—The Public Utilities Commission of Connecticut assigned the recent New Haven collision to six causes: Faulty signal system; running six trains during a fog in a ten-mile section of track; reckless running of the Bar Harbor express engineer in the fog; faulty flagging by the flagman of the Bar Harbor express; carelessness of the conductor in not seeing that his flagman had gone back a sufficient distance; reckless running of the engineer of the White Mountain express in a fog, and his failure to be prepared to stop at the signal.

The English Channel Tunnel.—Periodically there is a discussion of the proposal to build a tunnel beneath the English Channel between Dover and Calais. There are no insuperable engineering difficulties in the way of doing this, and the tunnel would lie throughout its length in a bed of firm, impervious chalk. Whether the scheme would be financially profitable is perhaps an open question; although statistics seem to show that there would be sufficient freight and passenger business to show a profit. Political and military objections, on the ground that such a tunnel would deprive England of its insular position, are losing weight, and prejudice on that score is disappearing.

The Largest Inland Water Steamship.—The "Seeandbee," a new side-wheel passenger steamer placed in service this summer between Cleveland and Buffalo, is the largest side-wheel steamer in existence. Five hundred feet in length over all, she has an extreme beam over the guards of 98.6 and a depth of hull at the stem of 30 feet 4 inches. The "Seeandbee" has six decks, and provides over five hundred staterooms. She is driven by engines of 12,000 horse-power at a speed of 22 miles an hour. The crank shaft of her inclined reciprocating engine weighs 120 tons. She has stateroom accommodations for 1,500 people, and carries a permit for 6,000 people. Her freight capacity is 1,500 tons.

Proposed New Navy Yard at New York.—The Secretary of the Navy recently inspected the site for the new proposed navy yard at New York, suggested by Capt. Van Duser. It is proposed to abandon the present navy yard at Brooklyn, which it is believed is worth from twelve to sixteen million dollars if turned over to the city; and to locate a new yard, containing berthing accommodations for forty battleships and providing two drydocks, each 1,200 feet in length, in the shallow part of New York Bay lying between the present channel to the southward of the statue of Liberty and New Jersey. Larger accommodation, with thoroughly modern layout; accessibility at all hours of the day; and convenience to the great lines of railroad transportation, are the principal advantages to be secured.

Cunard Line Abandons Queenstown.—The Cunard Line announces that for the future its steamers "Mauretania" and "Lusitania" will make no call at Queenstown, the change being due to the desire to avoid the risk which these large ships incur when they enter that port. A good reason for the change is seen in the fact that on only forty-five occasions out of the one hundred and fifty-four passages across the Atlantic which these two ships have made, has it been possible to leave the mails at Queenstown. Next spring the company will place in service the 900-foot "Aquitania," which will probably be a 23.5 knot ship. The change, so far as the public is concerned, will necessitate a somewhat earlier mailing to catch the boats at Liverpool. Queenstown, although admittedly a fine harbor, is too constricted for the safe maneuvering of the giant ships of to-day.

Three-cylinder Locomotive.—At the last annual convention of the American Railway Master Mechanics Association, Mr. J. S. Bell read a paper on the subject of three-cylinder locomotives, in which he gave particulars regarding three of this type which have been giving good service on the Philadelphia and Reading Railway. The three cylinders are placed on the same horizontal plane, one between the frame and other two exterior to the frame. They have the same diameter, 18½ inches, and each has its own piston valve. They have been engaged for several years in fast passenger service, principally on the New York division of the road, where they have been doing very satisfactory work. Their principal advantages are that they secure a uniform turning moment, the cranks being placed at 120 degrees; they exert greater tractive power, and they call for a lower factor of adhesion than two-cylinder engines. They are easy on rails and bridges; afford opportunity for better balancing; and can be operated on the simple, compound, or triple-expansion principle.

Electricity

Indicator Push Button.—Patent No. 1,021,335 describes a push button for an electric doorbell which is provided with a cap that may be turned through an angle of 180 degrees to the right or left to expose the word "out." This will indicate to the caller that no one is at home, and it will be unnecessary for him to push the button and waste battery current. If a doctor's office were equipped with such a button it would prevent the disturbing of other members of the family when the doctor was not in.

Conductivity of Magnetized Graphite.—Morris Owen, says the *Canadian Engineer*, while investigating the magnetic properties of the elements, found that graphite was particularly susceptible to magnetization. This led G. E. Roberts to investigate the electrical resistance of graphite when magnetized. At first he experimented with lead pencils and then with bars of various graphite. When the graphite was magnetized with the lines of force at right angles to the planes of cleavage, the electrical resistance was increased several hundred per cent in some cases.

Lighting and Heating Exposition.—The Imperial Russian Technical Society will hold an exposition of lighting, heating, and fire extinguishing devices in St. Petersburg, from November 1, 1913, to February 1, 1914. The lighting section will include oil, gas and electric lamps, illustrating their use in the illumination of the home, public buildings, and streets; lighting of railways, engineering, mining works and factories; in signaling; the lighting of vehicles; the production of light effects in theaters; the reproduction of moving pictures, photography, scientific work, etc.

Importance of Good Factory Lighting is emphasized in a paper by M. H. Flexner and A. O. Dicker read before the Illuminating Engineering Society at Pittsburgh, Pa. They show that foreign countries have taken up the question a little more seriously than we have. They have had committees appointed by the government whose duties are to study the effects of good and bad light on the general health, and report upon methods of bettering conditions. Apparently, it is the first cost of the installation that stands in the way of better lighting, and the authors of the paper have endeavored to show how easily and cheaply conditions can be bettered.

New Wireless Bulletins from the Eiffel Tower.—Since the first of September a special meteorological bulletin for aeronauts has been sent broadcast twice a day, at 10:45 A. M. and 5 P. M., by radiotelegraphy from the Eiffel Tower. The morning bulletin includes the brief report of meteorological conditions at points on both shores of the Atlantic, heretofore issued for the benefit of mariners, and, in addition, weather reports from 14 places in western Europe, a forecast of wind and weather for France, the force of the wind at the summit of the Eiffel Tower at 7 A. M., and its probable force during the afternoon. The afternoon bulletin is somewhat shorter but gives analogous information.

Improvements in Incandescent Lamp Manufacture.—In a paper by Ward Harrison and Evan J. Edwards, read before the Illuminating Engineering Society, Pittsburgh, Pa., it is brought out that the strength of tungsten filaments has increased more than 300 per cent since 1908, and the strength of drawn wire has increased 40 per cent since 1911. The use of chemicals in the bulb which has become general during the past year has reduced the blacking of lamps to a marked degree and has made possible a substantial reduction in bulb size for several lamps, thus reducing manufacturing costs and broadening the application of the lamps. The introduction of coiled filaments makes possible many new forms of lamps which heretofore could not be manufactured. The strength of the filament is increased by this process and the candle-power maintenance is not affected.

Electricity in Sumatra Mines.—In Sumatra, the extensive Ombiline coal mines are making use of electric methods on a large scale. In the present case the galleries run directly into the side of the mountain and lead to the mines proper which make up three levels. The coal is taken out of the mine by electric locomotives of the customary mining pattern which haul the trains of small cars. As the mines are higher up in the mountain than the railroad station of Sawah-Loento, the small locomotives are required to take the cars down to the loading station upon trolley electric tracks. Parallel to the first electric line has now been run a second trolley road, but this serves for large electric locomotives and cars which are used for hauling timber and other material needed for the mines. Current is also employed on a large scale for operating pumps, compressors, blast pans, cable hoists as well as in a coal bricket factory. Pumps bring the water from the river Ombiline, 5 miles distant from Sawah-Loento, and raise it to the mines, these pumps using two 200 horse-power electric motors. The current for the entire plant comes from a steam plant and also a turbine station erected on the Loento stream which sends current up to the mines on a high tension power line.

Science

Midday Darkness at Glasgow.—British newspapers report that on June 19th, while violent thunderstorms were being experienced in various parts of Scotland, a dense pall settled over Glasgow, and at noon the city was plunged in midnight darkness. Heavy rain fell soon after.

A Meteorological Station in Greenland was maintained all last winter by Drs. Stolberg and Jost, of the Swiss trans-Greenland expedition, in the vicinity of Godhaven on the west coast (latitude 70). The observers report remarkable alternations of temperature through the winter, occasional *föhn* winds from the east giving temperatures as high as 59 deg. Fahrenheit.

Prince Albert of Monaco, distinguished as an oceanographer, arrived in New York September 9th on his yacht "Hirondelle," which is especially fitted up for scientific investigations and carries a large scientific staff. He left two days later for a shooting expedition in Wyoming, the yacht meanwhile returning to France. Early in October he will visit the government scientific institutions in Washington and probably lecture before the Washington Academy of Science.

The Carnegie Explorers Are Safe.—Concerning the fate of the expedition headed by Dr. Alfred Mayer, director of the Department of Marine Biology of the Carnegie Institution, which sailed from San Francisco July 23rd for the East Indies, and was recently rumored to have been massacred by cannibals in New Guinea, the director of the Institution in Washington states that Dr. Mayer and his party have been heard from since the report of their massacre was circulated and they are undoubtedly safe.

Protecting Wild Plants in Great Britain.—The fact that several species of British plants, including some of particular beauty and renown, are in danger of extinction owing to ruthless gathering on the part of the public in general and nurserymen in particular, has recently formed the subject of many communications to the British scientific journals and newspapers, and was actively discussed at the last meeting of the British Association. Opinion seems to be divided as to whether or not the appropriate remedy is to be sought in state protection. Although many wild birds and other members of the animal kingdom are now commonly protected by law in civilized countries, there are few precedents for the state protection of wild plants (one of the few being the case of the climbing fern in the United States). The education of public opinion on this subject and other protective measures have been undertaken by a committee of the Selborne Society. One proposed remedy is the establishment of plant and fern sanctuaries, or at least gardens set aside in different localities where every rare British species might be carefully preserved and perpetuated.

The Scott Fund raised by the Mansion House committee in London will be divided between grants to the relatives of those lost in the recent expedition, the publication of the scientific results, and the erection of memorials. Lady Scott and Mrs. Wilson are each to receive £8,500; Captain Scott's mother and sisters, £6,000; Mrs. Bowers and her daughters, £4,500; while £3,500 is provided in trust for little Peter Scott. Smaller sums are allotted to the family of Petty Officer Evans. The sum of £17,500 is provided for working up and publishing the scientific results, which are to be edited by Capt. H. G. Lyons, F. R. S. The memorials will include a tablet in St. Paul's Cathedral, and a group of statuary, which it is proposed to erect in Hyde Park facing the new premises of the Royal Geographical Society. A particularly fitting scientific memorial is provided in the shape of a trust fund of some £10,000 for the endowment of future polar research. Although no provision is made for the relatives of the gallant Oates, who need no assistance, the members of his regiment are raising a fund for a memorial to him.

Foreign Names in French Journals.—Carelessness in spelling foreign names is not peculiar to any one country or to any one class of literature, but, with the possible exception of American daily newspapers, there are probably no publications in the world so remiss in this respect as the French journals of popular science, while most French periodicals and books of all kinds are not much better. The evil is not merely an offence to the purist, but sometimes has serious practical consequences, as when a reader wishes to consult the original publications of a writer whose work is quoted or abstracted, and whose name is so distorted as to effectually hide his identity. One of the journals classed above recently referred to Sir Oliver Lodge as "Olaver Ladgé;" another periodical, apropos of the record balloon ascent of Berson and Süring, transmogrified the names of these gentlemen into "Bergson et Kuhling;" Dr. H. von Ficker's recent studies of *föhn* winds are attributed in *L'Aerophile* to one "von Füker;" and so on, *ad infinitum* and *ad nauseam*. The Germans are generally more careful; though it seems quite impossible for a German writer to be satisfied with a single "n" in the final syllable of a personal name ending in "-man."

How Trees Are Converted Into Paper

A Trip Through a Paper Mill

By Thomas J. Keenan, F.C.S., Editor of *Paper*

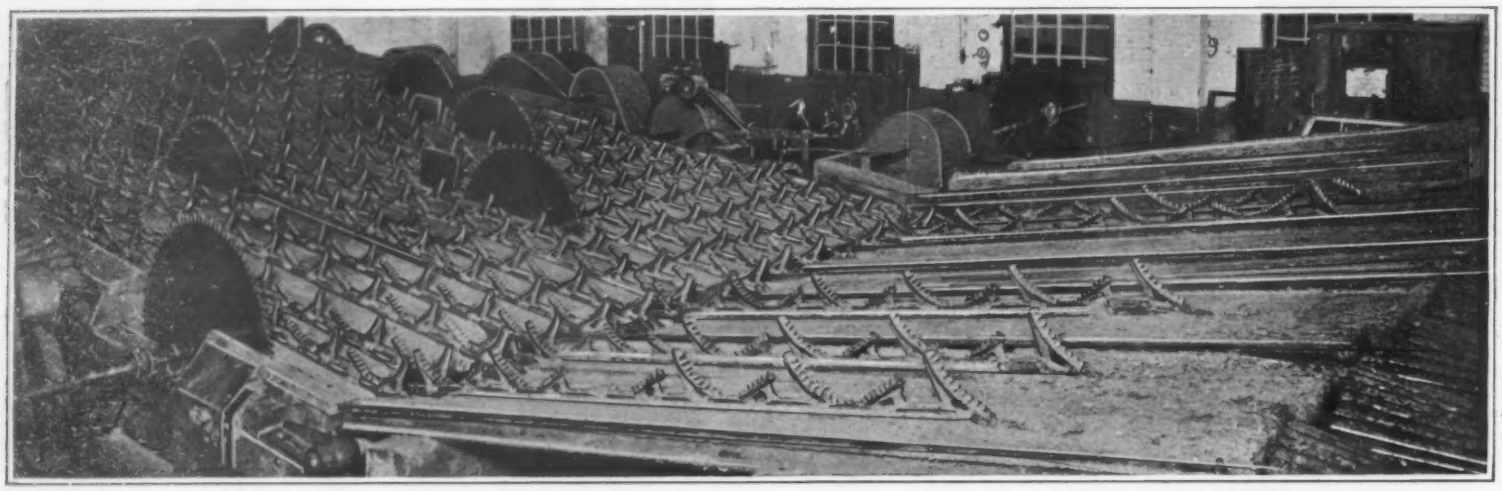


Fig. 1.—Slasher of a large ground-wood pulp mill. Here the wood is sawn into uniform pieces of the required size.

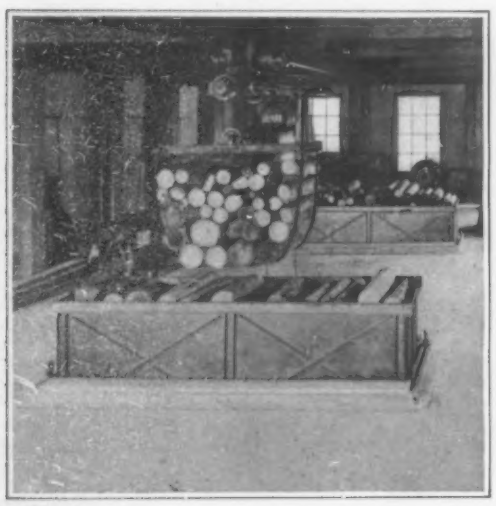


Fig. 2.—Charging a magazine grinder with wood. The grinder holds enough for a twelve-hour shift.

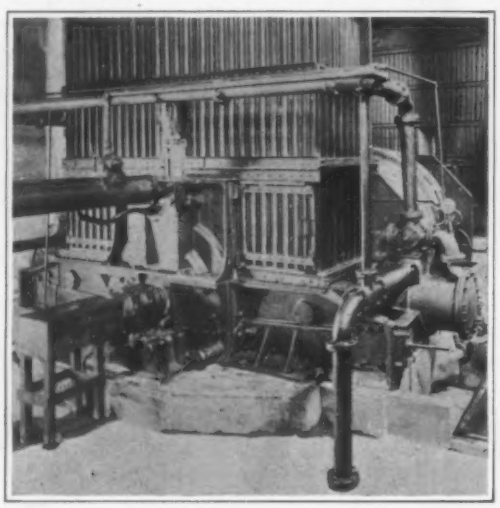


Fig. 3.—The newest type of magazine grinder in operation in a Niagara Falls paper mill.

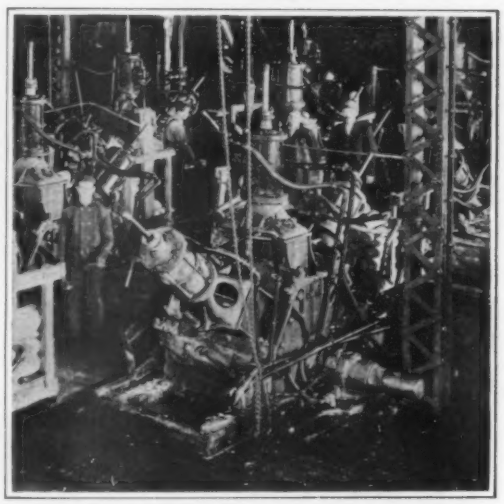


Fig. 4.—The ordinary type of grinder used in a ground-wood pulp mill.

A GREAT chemist once observed that a nation's wealth could be gaged by its consumption of sulphuric acid. He might have added that a modern nation's culture and refinement may be estimated by its use of paper. Granting this, the progress of the United States must provoke the wonder of the world, for from an unpretentious beginning the American industry of paper making has expanded during the past decade until the invested capital amounts to more than $400,000,000, with a yearly production approaching $300,000,000 in value.

The raw material of the paper on which the SCIENTIFIC AMERICAN and nearly all books, magazines and newspapers are printed is wood, but the process of production varies according to the quality of paper desired, and hence originate the different kinds and grades of book, magazine and newsprint papers.

Converting Trees Into News Paper.

The body of ordinary newsprint paper, such as makes up the interminable "extras" of a metropolitan evening newspaper, consists of a mechanically prepared pulp known as "ground wood," combined with a definite proportion of a chemically prepared pulp, which is called "sulphite" for short, and a certain amount of china clay to impart weight and an even surface to the printed paper.

The term "sulphite" as applied to paper is not so well understood as it might be, even by paper salesmen, and it is used very loosely by all classes of consumers, who appear to attach some derogatory meaning to the word. The name is properly applied to the pulp which is produced by boiling a selected wood, usually spruce, in a solution of the acid sulphites of lime and magnesia under high pressure, until all its juices, resins and gums, or non-fibrous material, are dissolved out and the skeletons of the plant tissue, constituting the fibers, or cellulose, are set free from their enveloping bodies. In the subsequent processes of washing and bleaching all traces of the sulphite liquor are removed, and the pulp so produced represents nearly pure cellulose in fibrous form. But this is a digression, and in order to preserve the proper order of description we will return to the basic substance of newsprint paper and view the transformation of tree to pulp.

While spruce wood was up to a year or so ago alone employed for the manufacture of ground wood pulp, balsam fir, hemlock, lodgepole pine, jack pine and mixtures of these woods are now used largely for the same purpose. This was made possible by a study of grinding conditions undertaken by Government scientists at the Forest Products Laboratory, Wausau, Wis. The wood is first freed from bark, then cut in lengths varying from 24 to 30 inches, or used full cord size of four feet, depending on the form of grinder used. There are only two pulp mills in operation in the United States equipped with the form of magazine grinder adapted to accommodate a full length log. In the ordinary form of grinding apparatus the piece of wood is forced by hydraulic pressure against a revolving grindstone under a stream of water in such a way that the pulpy fibers are torn from it obliquely so as not to divide them, but to preserve them as much as possible in their greatest length.

The stream of pulp flows by gravity to a screening apparatus where the slivers and unground lumps are removed, and the liquid pulp then undergoes a number of other screening, straining and dehydrating processes before it is considered sufficiently smooth and soft for pressing into laps, or is ready for the beating engine, if it is not to be stored, but converted directly into paper. In the beater the ground wood receives its admixture of chemical or "sulphite pulp" and the coloring matter, clay, rosin and alum, which go to make up the body of newsprint paper. After the addition of the required proportion of sulphite pulp, usually from 20 to 25 per cent, and a carefully measured quantity of blue and red dyestuff to correct the yellow tone of the pulp, from 5 to 15 per cent of clay is added, followed by a definite amount of rosin sizing (made by combining rosin with soda ash) and a quantity of alum sufficient to precipitate the rosin throughout the fibers, where it serves to bind them and make the finished paper partly resistant to the absorption of ink. Newsprint paper is but lightly sized compared with writing papers, bonds, ledgers, etc., which are doubly sized in the beater with rosin and with animal size or glue after they leave the drying cylinders.

The Evolution of a Sheet of Paper.

Having described the various processes employed in the manufacture of pulp it remains to follow the contents of a beater—the "furnish," as the assembled pulps, loading material and sizing are conveniently termed—through further refining measures and dilution until it passes, a thin milky fluid, from the flow box, through the slices, onto the swiftly traveling Fourdrinier wire, an endless band of copper gauze, which in addition to its forward motion has a regular reciprocating shaking motion, with a frequency of 300 shakes a minute. While the slowly forming tissue of interlocking fibers is being hurried on its way to the first press roll, the water drains away through the perforations in the wire, the thin film of pulp being further deprived of moisture in its swift passage to the driers by suction boxes or revolving suction rolls in contact with the under surface of the wire close to the couch roll where the wire turns on its reverse journey to the breast roll. The lifting of the delicate tissue of spider-web fineness from the wire onto the couch roll, when the machine is first started, is an astonishingly marvelous performance. The gauzelike web is transferred automatically from the running wire to the first felt and couch roll by a special attachment of great delicacy of operation. The thin tissue of paper is only in its formative stage here and, indeed, can scarcely be detected on the press felts. The clumsy touch of a man's hand would be fatal to its continuity, so this is regulated, as said, by a special piece of mechanism, which lifts it across the chasm from wire to felt as tenderly as a woman handles a new-born babe.

The Eternal Vigilance of the Paper Maker.

The subsequent management of the sheet in its journey under and over the drying rolls, which vary in number from thirty to forty, to the winder at the dry

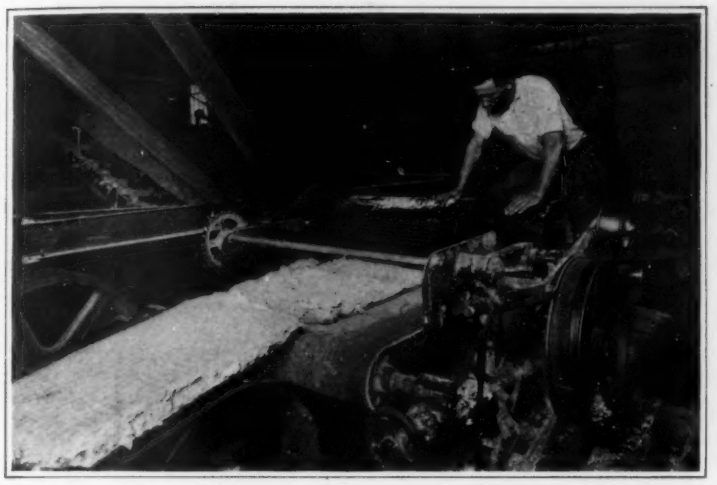


Fig. 5.—Shredding the baled ground-wood pulp in a Brooklyn paper mill.

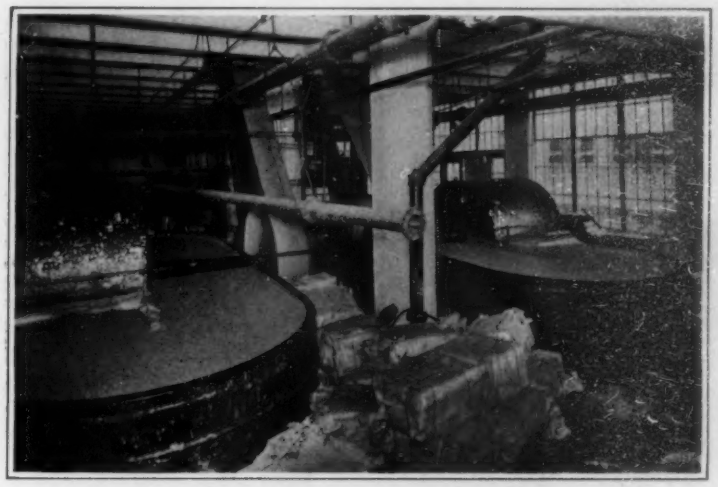


Fig. 6.—Beating engines in a Brooklyn paper mill; each holds a ton of pulp.

end of the machine (illustrated in colors in a fine artistic conception on the front cover page of this week's issue of the SCIENTIFIC AMERICAN) makes demands on the machine tenders which necessitate constant watchfulness and no little degree of muscular strength and activity of movement. If the stock has not been carefully ground and beaten, breaks are likely to occur with exasperating frequency and necessitate stopping the drying cylinders until the sheet has been caught and freed from a possible entanglement in the upper or lower tiers of driers; meanwhile the pulp at the wet end of the machine may be draining away as "white water" to be pumped back later through pipes and screens to the flow box, from which it again resumes its course over the traveling wire in the direction of the press rolls.

The idea of a machine for making continuous rolls of paper was conceived by a Frenchman, Nicolas Louis Robert, in 1798. The machine constructed by him did not produce a web of indefinite length, but one limited to fifty feet. An endless band of wire screen ran over two rollers. The pulp in the vat was conveyed to this wire by a blade wheel over a breasting. In its passage over the wire the water drained from it passed back into the pulp vat, which occupied nearly the whole of the lower portion of the machine and was used over and over again, as at present. The machine was worked by hand.

The Fourdrinier brothers (Henry and Sealy), whose name is perpetuated in the modern paper-making machine, obtained patent rights on the machine invented by Robert, in 1806. The paper made on the machine used by the Fourdriniers in their mill at Frogmore, England, was twelve inches to twelve feet wide, of a length not exceeding fifty-five feet. The machine was not equipped with a drying cylinder and the paper had to be taken off wet and hung up to dry.

It is a far cry from the days of Robert and Fourdrinier to the present time, when the Fourdrinier parts of a paper machine are made in instances of a width of 202 inches, while the wire, 200 inches wide, is capable of being speeded up to 800 feet a minute to make a roll of paper eight miles long!

What is "Sulphite" Pulp?

The perishable nature of ordinary newsprint paper is due to the presence in the ground woodpulp of the sap, lignin and resin of the tree, substances that oxidize rapidly on exposure to air and so discolor the paper and make it brittle. The sulphite process yields a pulp that is free from these objectionable products, which are decomposed in the cooking of the wood, or dissolved away and more or less completely washed out with the first waters after the pulp is discharged from the digesters.

Sulphite pulp is manufactured chiefly from spruce wood. The wood having been deprived of its bark, cleaned and cut up into pieces from two to four feet in length, as in the ground wood process, is chipped up into small pieces or chips about one fourth inch to a half inch thick and boiled under pressure in large steel digesters capable of holding twenty tons of wood at one operation and yielding ten tons of finished pulp. The digesters are lined with heavy cement backing, faced with brick, pointed with litharge and glycerin to avoid contact with the metal, and the huge steel cylinders are fortified against bursting under pressure and extremes of temperature by butt-straps on the inside and outside of the shell of steel.

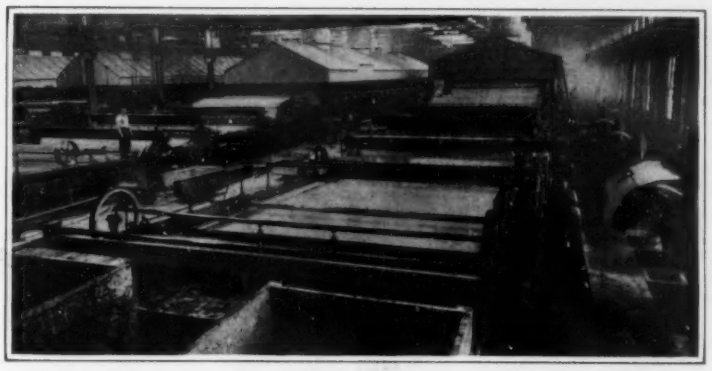


Fig. 7.—View of a large machine room from the "wet end" of a Fourdrinier machine. In the foreground is a machine that makes paper 184 inches wide.

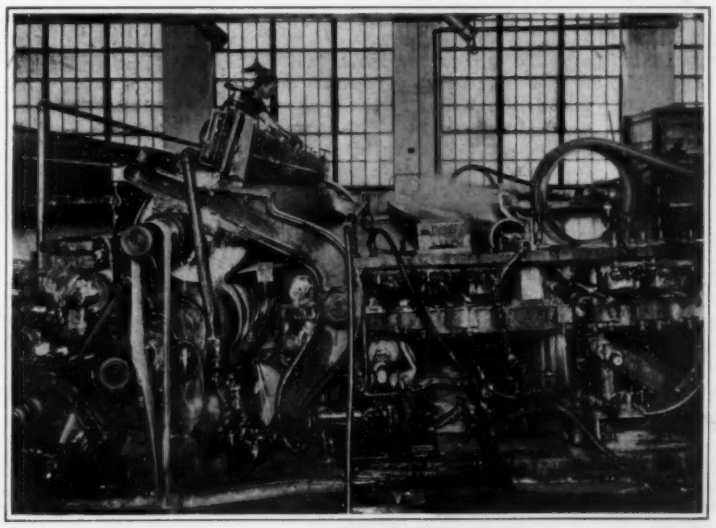


Fig. 8.—At the couch roll where the wire reverses. Here the delicate gauze-like tissue is lifted from wire to roll.

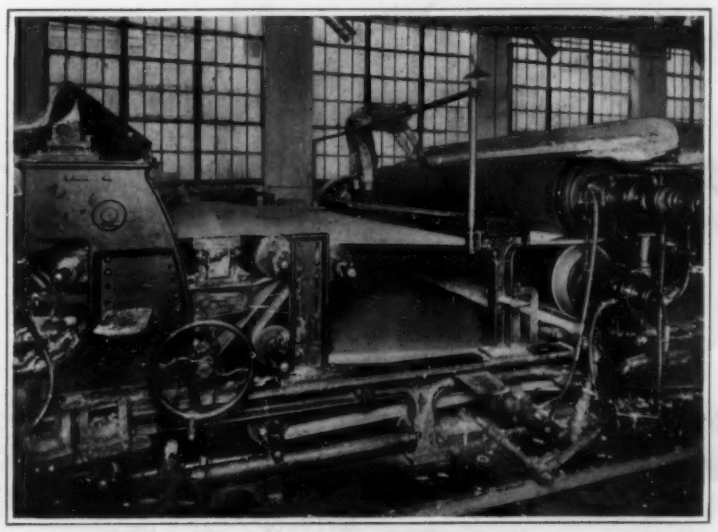


Fig. 9.—At this point the paper begins to form on the Fourdrinier machine. The machine attendant is fussing over the "doctor," which scrapes the roll.

The sulphite liquor in which the wood is boiled is made by passing sulphur dioxide—obtained by burning either sulphur or iron pyrites in special ovens—into tanks filled with water and a known quantity of slaked lime (prepared from dolomite). This results in the formation of a solution of the acid sulphites of calcium and magnesium, which is the active solvent agent. Ordinary limestone is used in many pulp mills, but dolomite yields a more powerful extractive solution.

When the digesters have been filled with the wood chips and the requisite quantity of sulphite liquor is added, the manhole or cover at the top of the digester is securely fastened and steam turned on gradually until the pressure reaches seventy or eighty pounds. The cooking is steadily maintained at this pressure for a period of eight to ten hours. At the end of this time the contents of the boiler, consisting of the disintegrated fibers of the wood, are discharged into large vats and washed. The spent liquor containing the dissolved resinous and non-fibrous portion of the original wood is allowed to drain away, and the tank is then washed out and made ready for another charge.

Sulphite pulp is increasing in use throughout the country. The quantity used during the decade 1899 to 1909 increased 781,759 tons, and of the entire quantity of woodpulp used in 1909, the latest census figures available, sulphite pulp constituted 42 per cent as compared with 35.6 per cent in 1899. The output of sulphite pulp increased 144.6 per cent during the decade and that of ground woodpulp 101.1 per cent. A constantly increasing amount of sulphite pulp is imported annually from Canada, Sweden, Norway and Germany.

The Process of Making Soda and Sulphite Pulp.

The soda process, yielding so-called soda pulp, is used for soft woods like poplar, cotton and basswood, whereas the sulphite process is exclusively employed for coniferous woods. The chipped wood is boiled in a solution of caustic soda for eight or nine hours at a pressure of seventy or eighty pounds. The pulp produced is soft and bleaches well, making it especially well adapted for the manufacture of book and magazine papers. The better grades of magazine paper are composed of a mixture of sulphite and soda pulps, and these, if thoroughly well cooked and

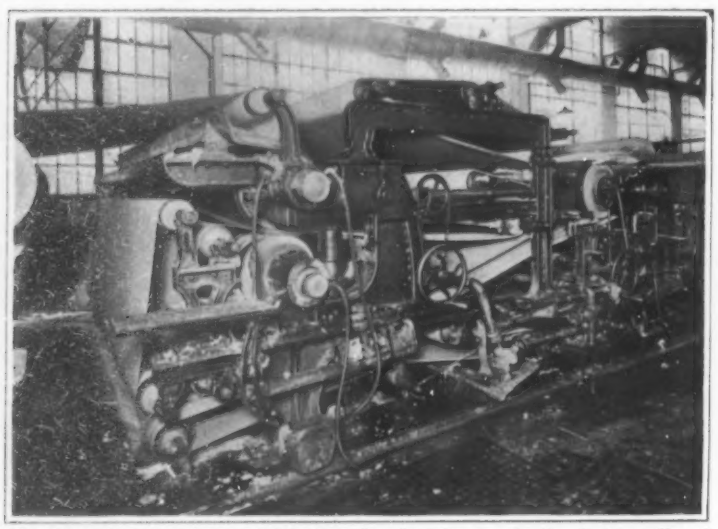


Fig. 10.—The paper is now fully formed and on its way to the drying rolls, of which there may be as many as forty in a large machine.

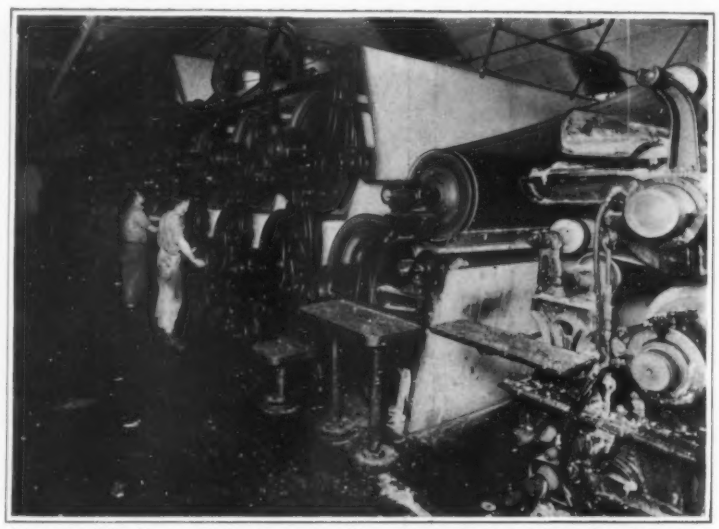


Fig. 11.—The dryers of the paper machine. To prevent condensation heated air is forced into the room and a current maintained by exhaust fans.

carefully bleached, are almost equally as permanent as rag stock.

Sulphate pulp is prepared by boiling the wood chips in a solution of sodium sulphate containing some caustic soda and sodium carbonate. It is a slower process than either the sulphite or the soda, as the period of boiling instead of being eight or nine hours is sometimes extended much longer, though good results have been obtained with a modified process in which the period of cooking is much shortened. The process is a more economical one than the simple caustic soda boiling, since, notwithstanding the ease with which most of the active chemical agent is recovered in the latter, there is still a loss of 8 to 10 per cent, even with efficient recovery plants. In the sulphate process this loss is made up by the addition of sodium sulphate (Glauber's salt) in the place of caustic soda, thus effecting a considerable economy, as the price of caustic is much higher than sulphate. The principle of the process depends on the fact that in soda recovery, when the concentrated liquors remaining after all the cellulose has been extracted from the wood are burned to ash, the sulphate reacts with the organic matter in the liquor and is thereby reduced to sulphide, and by its presence in the liquor subsequently made oxidation of the fiber is prevented, so that a good yield of strong pulp is obtained. The so-called "kraft" papers are made by this process, which is not a popular one, as the gases formed have a very offensive odor, like that of rotten eggs, which affects the whole neighborhood of the mill and makes the atmosphere almost unendurable.

The manufacture of sulphate pulp promises the development of a great industry in the Southern States, where there is an abundance of raw material in the pines indigenous to that region. The profitable disposition of the whole timber as well as the waste and stumpage of southern pines in the manufacture of paper pulp is a problem on which the Forest Products Service of the United States Department of Agriculture has been working for the past two years, with very encouraging results. It has now been established that long leaf pine is well adapted for the manufacture of natural-color "kraft" pulps and paper, the heavy brown wrapping paper of the stores, and that by the sulphate process a grade of "kraft" paper can be made equal or superior in quality to the imported or domestic "kraft" papers now procurable. A large company has been recently organized to build a mill in Florida, and this is regarded as the entering wedge for a number of similar exploitations.

The Disposition of Waste Liquors.

One of the weightest problems confronting the manufacturer of chemical pulps to-day is the disposition of waste liquors. He is eager to be informed of a means of utilizing the spent lyes from the sulphite process that would obviate the present necessity of throwing them into rivers and streams in such large quantities as has been done up to the present time.

By neutralizing the waste sulphite liquor and starting fermentation of the contained sugars, alcohol of a low grade is produced from it in several pulp plants in Sweden, and by a patented concentration process used in the United States, a compound is separated, which is utilized as a binder in road making, as a tanning extract and as an adhesive for sand in making molds and cores for iron in foundries. But the profitable recovery of the organic matter dissolved from wood in the sulphite process is still an unsolved problem, notwithstanding the fact that it has been deeply studied by able chemists for more than twenty years past.

In the soda and the sulphate processes of pulp making there is effected a partial recovery of materials and of power; by incinerating the spent soda liquor, after evaporating and concentrating it, the soda itself is regenerated, but there is a total loss of the organic derivatives of the wood, which are burned up in recovering the soda.

A Modern Tendency in Manufacturing Paper.

Ten years ago it would have been deemed exceedingly difficult, if not impossible, to operate a paper mill at any distance from the sources of supply of wood and of power, that is to say, from a well watered forest region, but during recent years, in the progress of the paper-making industry, water and steam have been generally displaced by electricity as motive power, developed by turbo-generators, and the machinery of modern paper mills is driven by direct-connected motors in place of the shafting and belting which distinguished the older mills.

An interesting development in the manufacture of newsprint paper is being witnessed in the harbor of New York, a paper mill having been constructed on the South Brooklyn waterfront with a capacity of 100 tons a day. The ground wood pulp is manufactured in Canada, and brought to New York Harbor in cargoes of 5,000 tons by steamship and landed at the dock of the paper mill company, a few hundred feet distant from the manufacturing plant. The pulp arrives in bales weighing about 400 pounds each. In a building on the dock the pulp is passed through a shredder, where it is finely divided and agitated with water until it is reduced to a fluid form, when it is pumped directly to the beating engines in the mill proper. As the pulp enters the beaters, of which there are six (three for each paper machine), each capable of holding 2,200 pounds of material, there are added to it 20 per cent of sulphite pulp, the clay, coloring matter and sizing which complete the "furnish." The mass is beaten and circulated in the engines for one hour, after which it passes down to a large concrete tank in the basement, called the "stuff chest." Here it is diluted with a large quantity of water. Next it is drawn up by powerful pumps and passed through a Jordan engine.

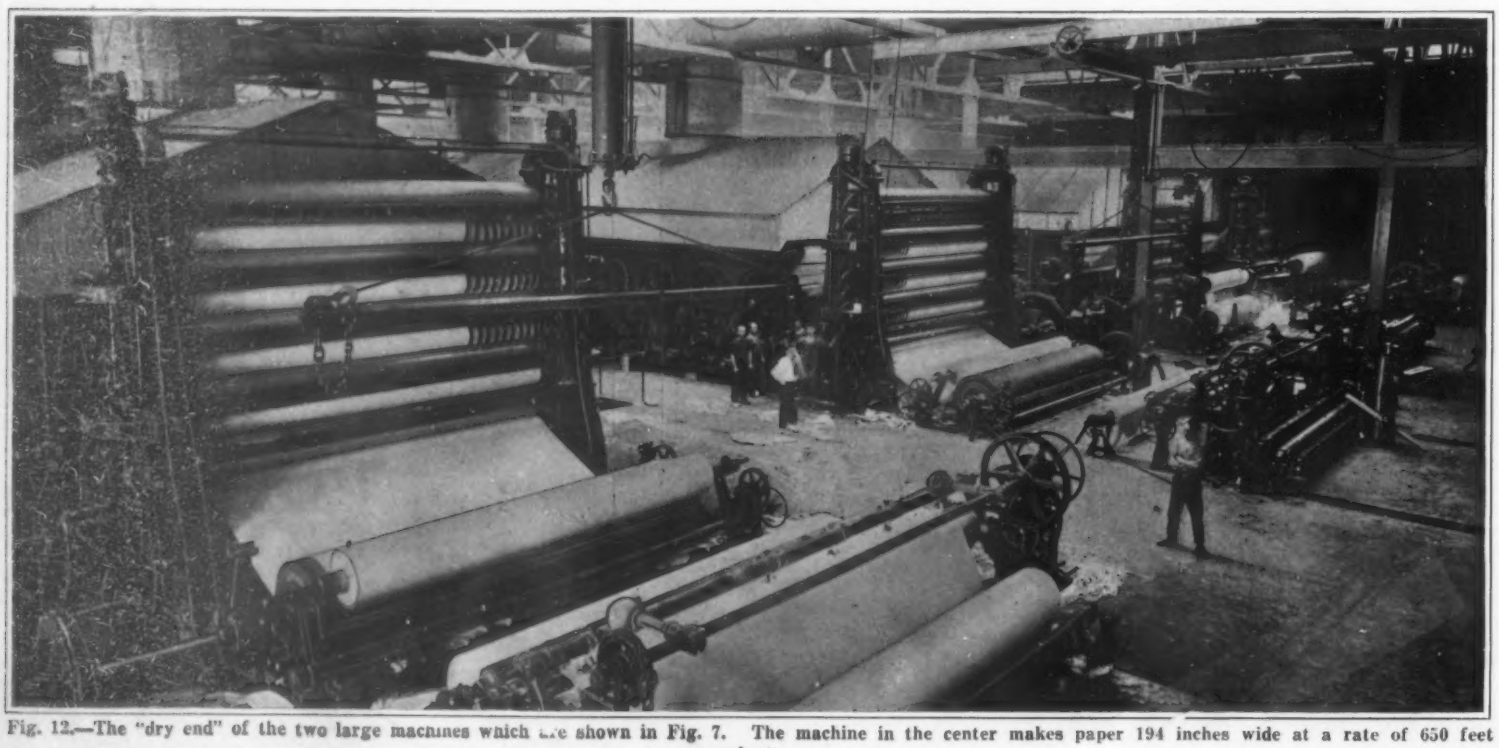


Fig. 12.—The "dry end" of the two large machines which are shown in Fig. 7. The machine in the center makes paper 194 inches wide at a rate of 650 feet a minute.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Sea-level Canal Fallacies

To the Editor of the SCIENTIFIC AMERICAN:

I have been considerably interested in reading your article on the above subject in your issue of the 16th ultimo.

I have no doubt that this article will invite controversy, as I do not think that your correspondent's views are altogether sound. There are many critics, I imagine, and also some of the best engineers in the States, who believe that it might have been possible, and indeed *better*, to have built the Panama Canal at *sea-level*.

You say that you doubt that any engineer could be found to-day who would advocate such a canal. I do not think that there would have been any difficulty in finding such an engineer, but would prefer not to mention names at the present time.

Further, I do not understand why you lay down as a kind of axiom that *any kind* of a canal at Panama *must* be provided with locks. When we consider the comparatively short time of tidal flow, that the canal is nearly 50 miles long, and that the Gatun Lake has such a large volume, does your correspondent seriously put forward that this ten feet difference of tide would cause such a current as to render navigation difficult, especially in a canal with such a large cross section?

Judging from the experience in the Manchester Ship Canal in England and in other ship canals in Canada and the United States, I do not believe that the current would be large or difficult to navigate.

With respect to the question you have raised about the size of ships, as the locks will certainly out-live (the effect of earthquakes excepted) the "life-time of the youngest child that can read the SCIENTIFIC AMERICAN," I do not think that your argument is a reasonable one, and do not see any reason why, in some future, ships using the canal should not be existing which would require longer locks than those provided.

Later, you say "nature has decreed that no sea-level canal shall ever be constructed at this isthmus." I do not think that there is any evidence of such a decree, and I do not believe that there is any doubt that a sea-level canal could be constructed.

The Culebra cut is certainly a deep excavation; but should the further 85 feet below the present bottom of the prism prove to be rock, there would be no further difficulty caused by the slipping of the slopes; should, however, it prove to be soft, certainly, as a last resource, this extra depth of the cutting could have been removed by *dredging*, in which case the water would assist to support the sides of the prism.

In your last paragraph you practically say that it may be stated that if the canal were cut through the "divide" down to sea-level, the time and cost of construction would be *doubled*. I do not see any reason to believe that such a "hard-and-fast" statement would be true.

Finally, I have heard it stated that the canal is being constructed as a lock canal on a *minority* report, and that this was done for the reason of expediency; if this be so, it would certainly show that some well-known engineers believed that the sea-level canal was not only possible, but certainly desirable.

I am now crossing over to Europe, and hope that you will have some further reference to this interesting subject from your correspondents.

R. M. S. "Lusitania." M. I. C. E.

[This letter is discussed on our Editorial page.—ED.]

Prevention of Aviation Accidents

To the Editor of the SCIENTIFIC AMERICAN:

The recent fatal accident to Ensign Billingsley of the U. S. Navy, with the miracle-like escape of his companion, Lieut. Towers, would seem to furnish an explanation of many other aviation accidents and suggests two things that should be done to prevent similar accidents in future. The survivor explains just how the mishap occurred, an upward wind gust having evidently struck the tail, or rear elevator, causing the machine to suddenly dive forward and downward, throwing out Billingsley, who was hurled 1,600 feet to his death, while Towers clung to an upright and survived when the machine crashed into Chesapeake Bay. A quite similar accident befell an army aviator, Capt. Hennessy, at San Diego on July 9th, only he succeeded in regaining his seat and righting the aeroplane after being thrown forward from his seat when a warm ascending air current evidently struck the rear elevator. Harriet Quimby and her passenger were thrown out one after the other in this same way, as was also Moissant, and it is not necessary to mention the numerous other aviators who are known to have perished similarly. The two lessons to be learned from these cases are: First, that the aviator and passengers should be held in their seats by a strap or similar device passing in front of them but of course instantly removable when desired, and second, that all aeroplanes should be provided with both front and rear elevators, so that in case of a strong ascending or descending current striking one but not the other, or striking them at different moments, the opposite one would instantly oppose to a great degree any sudden upward or downward movement, even before the operator could adjust the elevators to counteract the movement; for with the two elevators connected, if the rear flap were forced upward despite the aviator's grasp on the lever, the front flap would turn downward to elevate, as needed, anticipating or at least aiding his movement of them; and if the elevators included little or no fixed horizontal surface, but simply consisted of planes pivoted at points much nearer front than rear of them and turnable through sixty to ninety degrees, with stops on each side, such upward or downward air currents could not materially upset the longitudinal balance of the machine; but if, with considerable fixed horizontal surface attached, the strong upward or downward current, acting on it as on a sail, should break or disable one elevator, the aviator would still have the other one to depend upon for safe landing, more especially if each elevator were connected by its cable to a separate lever, with the two levers arranged side by side so as to be grasped in the one hand, and by having pulley belt-tighteners attached to each or one elevator cable the relative angles of the two elevators could be changed during flight or set as found best by means of levers connected therewith.

In conclusion, the writer is convinced that all aeroplane controls should be duplicated. For instance, the ordinary rear vertical rudder for lateral steering, and on which the lateral balance so much depends, especially at times, should be duplicated at the front (as I believe is done only in Capt. Cody's machine), or else pivoted vertical resistance surfaces could be easily provided at the lateral ends for steering purposes, as in some aeroplanes, or all three steering methods used, two or three levers being preferably arranged to be grasped in one hand for the purpose, as above described; for a contrary side gust may sometimes prevent a rear or front vertical rudder from steering the craft as desired, or as necessary to preserve balance.

By using such duplicate controls, the writer believes that aeroplaning will be made as safe as it ever can be; for I venture to predict that the successful, safe, and efficient flying machine of the near future will be a combined helicopter and aeroplane. It is with the hope that these suggestions may help to lessen the death toll of aviation that they are here given, and more may follow later. ELMER G. STILL.

Livermore, Cal.

Fire Protection by Automatic Sprinklers

To the Editor of the SCIENTIFIC AMERICAN:

The second editorial in your recent number referring to the disastrous fire in Binghamton is all right so far as it goes, but it strikes the writer that it missed one of the strongest points which could have been made with regard to improvement in conditions which would make impossible a repetition of such catastrophe.

In the August number of the *Journal* of the American Society of Mechanical Engineers, the case is very well put on pages 1272 and 1273, as well as, in a certain sense, the remarks at the bottom of page 1269 and top of 1270. Particularly in the middle of page 1272 is the point made clear, that every time a sprinkler operates from fire in a building full of people, it is a potential life saver.

The writer has been studying this subject of Automatic Sprinklers, and their use in saving both property and life, for some little time. So far as I have been able to learn, there have been just eight deaths by fire in factories protected by automatic sprinklers. In not a single one of the eight cases could the death be charged to the failure of the sprinklers to operate properly, as you will see by considering the details.

In January, 1907, under peculiar circumstances, a fire gained great headway in the Cocheco Mills, Dover, New Hampshire, at a time when the automatic sprinkler system had been temporarily shut off for adjustment. This was a cotton mill, and the spread of the fire was so rapid in the cotton goods on the machines, and up through belt ways, etc., that five of the employees, who attempted to save their belongings in their lockers, were overcome by smoke, and lost their lives. The sprinklers were not operative at the time the fire broke out. Before they could be adjusted and put in service the damage had been done. This is, of course, a strong argument in favor of keeping all such equipment at all times ready for immediate service.

About a year ago a celluloid comb factory near Boston was the scene of a fire which flashed all around the room in the scraps of extremely inflammable celluloid on the work benches, making a complete circle of flame, which shut off the access to the stairs. About a dozen employees in the room dashed through the flame and down the stairs, all being more or less severely burned, and two of them losing their lives. Please note: Before the fire department arrived on the scene the automatic sprinklers had the fire *completely out*. It would, of course, be too much to have expected the employees to remain within the circle of flame for the sixty or ninety seconds required by the sprinklers to put out the fire. Probably no human being under such circumstances, and with the panic which is always connected with fire, would have remained at this time. It is perfectly clear that if all the employees *had* remained in the room, the chances are that none of them would have been severely injured.

The other case where life was lost under automatic sprinklers was in a piano factory in New Jersey also about a year ago. The watchman's lantern exploded, while he was making his rounds, and set fire to the inflammable varnishes in the room through which he was passing. He was so severely burned as a result of the initial explosion that he died the next day. The sprinklers held the fire from spreading, giving the firemen an easy task in putting the fire out.

Practically every expert who reported upon the results of the Asch Building fire in New York two years ago said that automatic sprinklers would probably have prevented the loss of life in that building. As you probably noted, automatic sprinklers have been since installed throughout that building.

The National Fire Protection Association shows records of some 15,000 fires in which automatic sprinklers have figured. The three cases above mentioned are the only ones in which loss of life has occurred, and the circumstances, in those cases, were so peculiar that as matters stood, the sprinkler may be said to have a clear record, so far as life saving is concerned.

The installation of fireproof stairways will do much to help matters along. They are, however, no means of surety against panic, and should be considered simply as one of a number of devices, all with the same end in view. They would probably be more expensive to install in an existing fire-trap than would a satisfactory system of automatic sprinklers. They would be less effective as a life-saving device, and not at all effective, from the dollars and cents standpoint upon the saving of property. Sprinklers would save *both* lives and property, and pay for themselves in a period of four or five years, through reduction in insurance rates. Which, under these circumstances, do you consider the better scheme to advocate?

So far as the fireproof building is concerned, the stairway will not make it more fireproof, and in very tall buildings, such as some of the loft buildings in New York, the space requirements for such a stairway to accommodate hundreds of operatives all at the same time, would be prohibitive. The sprinklers, by confining the fire to a mere handful of flames, so to speak, would make it unnecessary to empty the building in any such hurry, and would soon come to be recognized in its true light, as a life saver and a panic deterrent.

Cases are on record where a fire in a waste basket full of paper has been put out by a sprinkler before the waste basket was consumed. The sprinklers operate without human assistance, are not subject to panic conditions or excitement, are not hampered by smoke or a sudden flash of flame, are not hindered in their work by a rush of frightened human beings running away from the seat of disturbance.

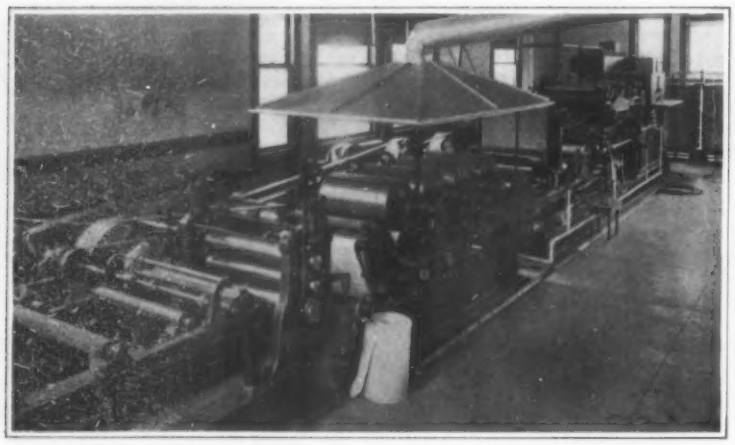
To my mind they are the only great saving factor in our fight against fire, and should be required (legally) in all manufacturing plants subject to destruction. They can be put into existing buildings at nominal expense, and render what is now a fire-trap, more safe as against both panic and loss of life, than any "fireproof" building now existing, which does not contain sprinklers. If you consult the real estate advertising pages of the *New York Herald* you will find building after building designed for loft and manufacturing purposes making capital of the fact that they are protected by automatic sprinklers.

I have nothing to do with sprinklers from any business point of view. I am, however, intensely interested in the very live subject of the conservation of life and accumulated resources. SIDNEY G. KOON.

Boston, Mass.

[The writer of the above letter is in error in his supposition that the editorial referred to advocated the building of fireproof stairways as the sole protection against fire; nor will even a cursory reading give this impression. Automatic sprinklers are one very efficient and well-established method of fire protection, as the facts given in the above letter will show.—EDITOR.]

Street Accidents in London have increased at an alarming rate with the increasing use of automobiles. Giving evidence before a parliamentary committee on motor traffic in London, Colonel Hellard, chief of the London traffic branch of the Board of Trade, recently stated that in the metropolitan area last year there were 537 deaths from street accidents, as compared with 155 in 1904, while over 20,000 persons were injured, as compared with about half that number in 1904.



A complete paper making plant in miniature.

Paper testing laboratory of the National Bureau of Standards, Washington.

How the Government Tests Paper

The Methods and Machines of the Bureau of Standards

By Herbert T. Wade

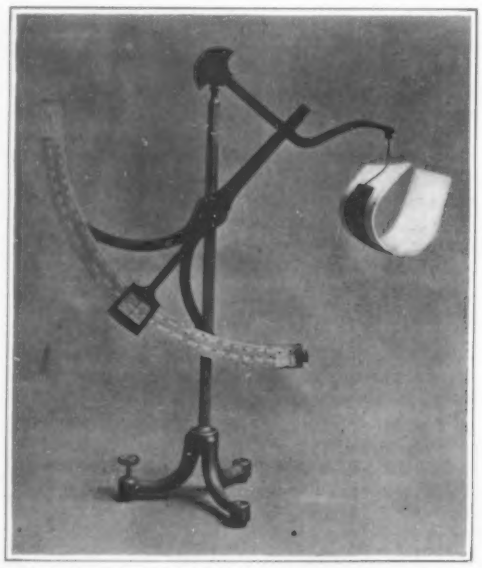
EVERY year some 40,000,000 pounds of paper, including almost every variety, is delivered to the National Government for use in the manufacture of bank-notes, postage stamps, and post cards, and for printing, stationery, and other purposes. Every year a continuous succession of valuable documents is issued from the Government Printing Office, and it is obvious that the purchase and test of paper is no small matter.

For the sake of completeness and fairness the methods of test are made as comprehensive and scientifically exact as possible, thanks to the co-operation of the National Bureau of Standards in Washington. For some ten years this bureau has been carrying on a complete investigation of the technology of paper making, not only with the idea of making the ordinary routine tests involved in passing on Government supplies, but also with the aim of evolving standards of material and product as well as standard methods of testing. These would find expression in standard specifications leading to uniformity in the paper furnished under the various contracts, and afford opportunity for an ordinary buyer better to determine the quality of paper.

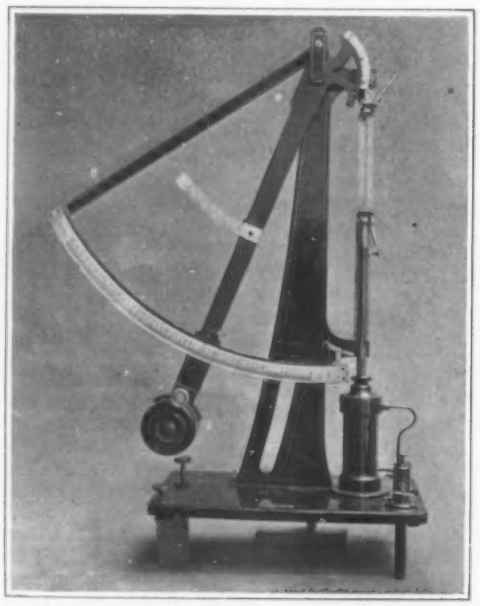
It might be said in passing that in Germany such investigations have been carried on for a much longer period, and that the most systematic studies of paper making and its materials have been made and accurate and elaborate methods and machines for testing have been developed. In fact, the German investigators have even made a scientific classification of papers based on their chemical and physical properties as ascertained by analysis and test, but so refined and minute is much of their work that it is said to be in advance of present conditions in the German paper trade.

At the Bureau of Standards there is maintained a special paper-testing laboratory equipped for microscopical examinations, chemical analyses, and physical tests and supplied with instruments and apparatus representative of the best American and German scientific and commercial practice. There is also a small size paper-making plant where the pulp can be prepared and actually worked up into paper on a paper-making machine. The aim is to produce standard paper samples in which the fiber content and other materials and the actual processes of manufacture are accurately known, so that when specifications are prepared for similar samples or product they are based on minute and systematic knowledge. In its work the paper testing laboratory seeks to co-operate with paper manufacturers generally, and the results of its investigations and researches are easily available, while its apparatus and modes of testing can be examined at any time by those interested.

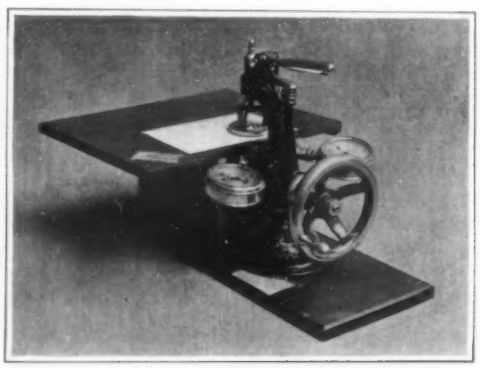
Aside from technologic research the testing of paper, as carried on in this laboratory, presents many points of general interest. The tests may be classed as physical, microscopical, and chemical, the first named, perhaps, being of the greatest concern to the ordinary user and consumer, and in addition being the simplest and most readily understood. The physical properties of course depend upon the chemical constituents and the methods of manufacture which can be determined only by analysis, but they afford a very good idea of the ordinary qualities and characteristics of the paper, particularly in connection with the special use for which it is designed.



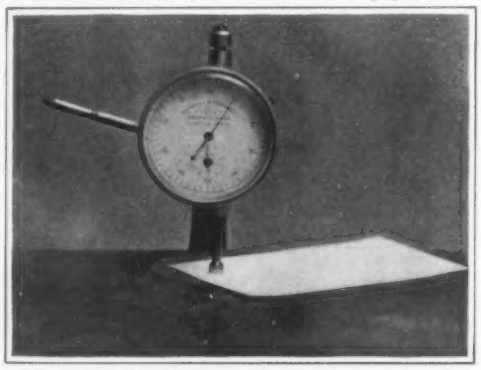
The quadrant paper scale. Reading the weight per ream from the test of a single sample.



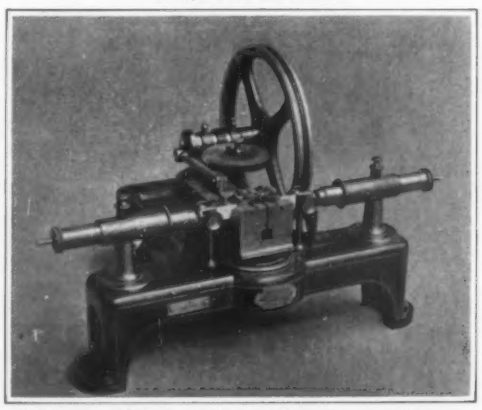
Schopper strip tester for measuring and registering breaking or tension strength and elasticity.



Mullen strength tester. A "bursting" machine that is extensively employed in the American paper trade.



Micrometer thickness tester. A gage reading to 1/10,000 of an inch.



Schopper folding machine. To measure the endurance of paper by mechanical folding of a strip.

How the Weight is Accurately Determined.

The first test to be applied is a determination of the weight of a given grade or sample. Paper is sold usually according to its weight per ream of 500 or 480 sheets, each 24 by 36 inches or some other standard size, as may be determined. A single sheet is taken, rolled up and weighed in a suitable scale or balance and from its weight the weight of the ream is computed, or in the case of the quadrant scale illustrated, read off directly for reams of 500 and 480 sheets from the graduated circular arm. Of course a smaller sheet or portion of a sheet may be used and the weight of a full size sheet or of a ream of any size sheets calculated from it. In large consignments of paper considerable unevenness is likely to be found, and in all testing care is always taken to se-

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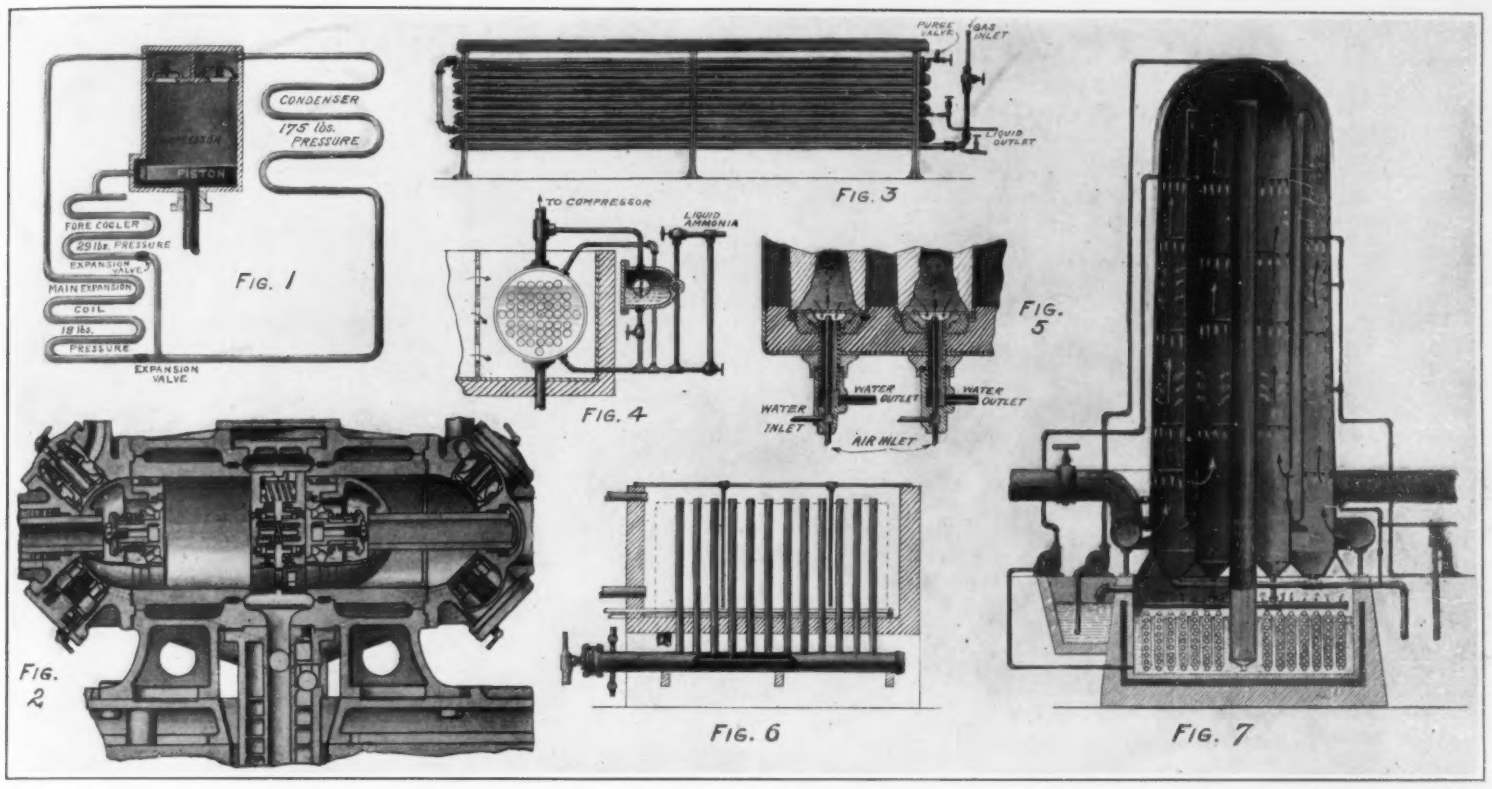


Fig. 1.—Diagrammatic view of a compression system, consisting of four main parts—compressor, condenser, expansive valve, and evaporator or refrigerator coil. Fig. 2.—Quadruple acting compressor, showing housing of valves in cylinder and pistons for keeping down heat generated during compression. Fig. 3.—Flooded ammonia condenser, atmospheric type. Hot gas is made to enter at bottom of coil instead of top. Fig. 4.—Section of shell brine cooler of flooded type in which brine to be cooled is forced through the pump tubes. Fig. 5.—Large detail section of freezing can employing raw water. Fig. 6.—Apparatus whose refrigerant may be brine or liquid ammonia. Ice increases in thickness in greatly reduced time around the tubes until the various masses meet and coalesce to form continuous cake. Fig. 7.—The use of refrigeration in drying of air for blast furnaces. One of the latest forms of cooling towers for this purpose.

New machines that produce cold.

Recent Improvements in the Refrigerating Industry

What the Inventor Has Done for Cold Storage

WHILE there are a number of different ways in which cold can be produced artificially, only the compression, the absorption, and the air expansion systems are of commercial importance, and they rank in the order given. The theory of operation of all three is comparatively simple, although in order to obtain the highest efficiency each apparatus is at times somewhat complicated. In all three types a substance known as the refrigerant is employed. This refrigerant acts as a heat carrier, taking up heat at a low temperature in the cooler and discharging it into running water. In order that the refrigerant may perform this function, work must be done. The refrigerant most generally used in the compression system is anhydrous ammonia, although carbon dioxide and sulphur dioxide are used to some extent.

It will be seen from Fig. 1, a diagrammatic view, that the compression system consists of four main parts, a compressor, a condenser, an expansion valve, and an evaporator or refrigerator coil. The compressor, in effect, is a heat pump, as it enables the refrigerant to perform its function as the heat carrier. In operation, it pumps ammonia vapor out of the refrigerator coil and forces it under high pressure into the condenser, where it liquefies, due to the high pressure maintained therein, usually about 175 pounds for ammonia, and to the cooling effect of the water flowing over the pipe coil. The heat removed from the ammonia in the condenser is of two kinds; that is, sensible heat or heat put in during compression (all gases generate heat when compressed) and the latent heat which the ammonia gives up in passing from the gaseous to the liquid state. The liquid ammonia then passes through the expansion valve into the refrigerator coil where it again evaporates or boils by reason of the heat from the substance to be cooled. As fast as the vapor is given off it is pumped out by the compressor, and it is essential that the pressure be kept comparatively low, for the boiling temperature of all liquids depends upon the pressure. Under 15 pounds pressure ammonia boils at zero Fahr.

It will be noted that the cooling effected is due to the latent heat absorbed in passing from the liquid to the gaseous state, and not to the expansion of the ammonia gas. The latent heat of ammonia is very marked; one pound of liquid ammonia evaporating at 15 pounds pressure, is sufficient to convert over four pounds of water into ice. The refrigerator coil is usually immersed in brine which acts as a heat conductor for transmitting heat from the ice cans or air to the coils. It is absolutely essential that the ammonia be in the liquid form as it enters the cooling coil, for otherwise no cooling will be effected. The compression system was invented by William Cullen, an American, who took out an English patent in 1755. This system did not come into general use, however, until about 1870, when ammonia was introduced as the refrigerant.

The absorption system was invented by Ferdinand Carre, of Paris, about 1850. In this system the compressor is replaced by a vessel partially filled with water. When cold the water readily absorbs all the vapor from the liquid ammonia evaporating in the refrigerator coil and forms the ordinary strong aqua ammonia. This aqua is then heated and the ammonia gas in dry or anhydrous condition is driven off under high pressure into the condenser, where it is cooled and liquefied in the same manner as in the compression system. In this simple form the machine is intermittent in its cooling, but by using a separate absorber and a pump to cause the liquid to circulate through the boiler and the absorber, the cooling operation can be made continuous. Absorption machines are still extensively used.

For many years the air expansion machine was more generally used than either of the two others mentioned above. It was invented by Dr. Gorrie of Apalachicola, Florida, in 1845, and was used for making ice. These machines have the same elements as the compression machine, except that the expansion valve is replaced by an expansion engine. As the air is not liquefied in the condenser it would not effect any appreciable cooling if allowed to expand freely through an expansion valve, but if allowed to expand against a movable piston so as to do external work, the expanding air reaches a very low temperature. The specific heat or heat-carrying capacity of air is very small compared with the volatile liquids used in the compression and absorption machines, so that these machines had to be very large and cumbersome. For this and numerous other reasons, this type of machine is not now extensively used except where very low temperatures are desired, as in the liquefaction of gases.

While the artificial refrigeration industry is one of comparatively recent development, its growth has been very rapid, and it now plays a very important part in the conservation and distribution of our food supply. The improvements in refrigerating apparatus and methods in the last decade have been numerous and important. These changes generally relate to improvements made in the construction and operation of the various integral parts rather than to the machines and processes as a whole, and to the extension of the industry to new fields.

Often in cold storage systems it is desirable to maintain different temperatures in various compartments; also in ice making the temperature of the fore cooler should be higher than that maintained in the freezing tank. As the temperature in a refrigerating coil is dependent upon the back or suction pressure, it is obvious that it would be difficult to maintain such difference in temperature by an ordinary compressor. To overcome such difficulty, the compressor shown in Fig. 1 was devised. During the first part of the suction stroke of this compressor, low pressure gas is drawn in from the freezing coil, and when the piston is near the end of its stroke, a part is uncovered, permitting gas of a higher pressure to rush in from the fore cooler. In this way the cylinder becomes filled with gas of the higher pressure maintained in the fore cooler and on the return stroke the port is quickly covered, the gas is compressed and driven into the condenser. As the refrigerating capacity of a compressor is proportional to the absolute back pressure at which it operates, it is obvious that this multiple effect arrangement greatly increases the capacity of the compressor, and especially so where carbon dioxide is used as the refrigerant.

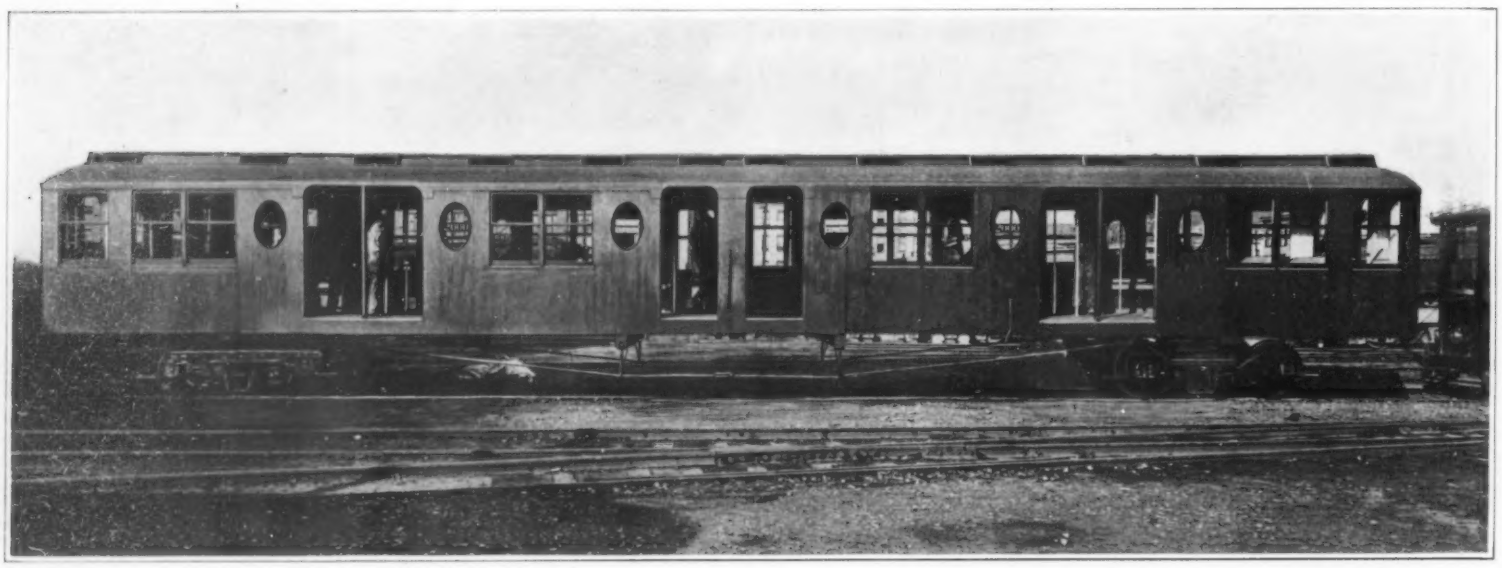
The quadruple acting compressor shown in Fig. 2, is a more recent product. About midway of the bore of the cylinder is placed a partition which also houses discharge valves. The two pistons have hollow piston rods provided with check valves for the admission of gas to two of the compression spaces. This feature is designed to keep down the heat generated during compression. It is obvious that this compressor has a large capacity for its size.

It is probable that less effort has been made to improve the condenser than any other one part of the refrigerating machine. For many years condensers were generally so constructed that the hot gas entered at the top of the coil and the liquid condensed was drawn off at the bottom. Recently, however, an improved form shown in Fig. 3 was introduced, in which the hot gas was made to enter at the bottom of the coil instead of the top. This simple change made it possible to reduce the size of the condenser one half or more and still obtain more satisfactory results than with the old form. This is due to the fact that the transfer of heat from the hot refrigerant inside the coil to the condensing water is about four time as rapid when the refrigerant

(Continued on page 272.)

A Car Designed for the New Subway

Providing 42 Per Cent More Seats and 100 Per Cent More Standing Room Per Passenger



Full-size model in wood of new steel subway car for New York Municipal Railway Company.

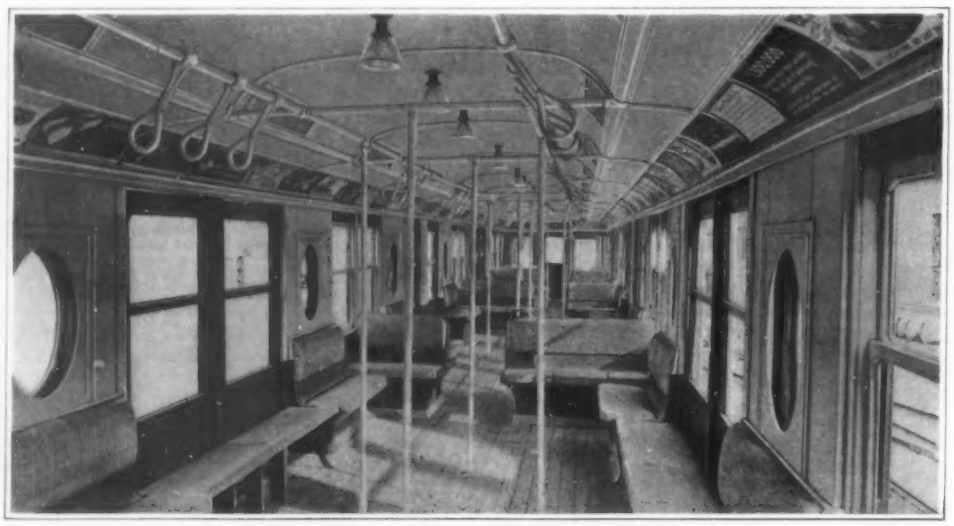
IN rapid transit service, the number of passengers that can be carried in a given time over a given length of road is determined, not so much by the speed of the trains between stations as it is by the time occupied at the stations in discharging and taking on passengers. In most large cities, the rapid transit passenger asks first: that he be taken to his destination as quickly as possible; second: that he be given a seat.

On the present subway of this city, as operated by the Interborough Company, the express platforms are about five hundred feet in length. This dimension determines the number of cars that can be run in a single train; and the express trains as now made up consist of ten cars, which, if loaded to their maximum sitting and standing capacity, during the rush hours can each accommodate twelve hundred people—this, be it remembered, representing the maximum possible accommodation when there is heavy congestion of traffic. Of the hundred and twenty passengers crowded into each car, forty-four will be seated and seventy-six standing.

The New York Municipal Railway, which will operate a part of the new dual system that is under construction, has designed a new car, in which they have sought to provide, on the basis of 1,200 people per train, a larger seating capacity, and a less crowded standing space for those who cannot secure seats. Also, by making a better distribution of the three entrances to each car, they have facilitated the loading and unloading of passengers, and so have cut down the time of stopping at stations.

The new car will, of course, be built entirely of steel; but to demonstrate to the Public Service Commission and to those who are interested in the problem, the general external and interior appearance of the car, the comfort and convenience of the seating arrangements, and the freedom of ingress and egress, the company have built at their yards in Brooklyn a full-size model car, of which we present the accompanying illustration.

It will be noticed at once that the car is very much larger than those in use in the present subway. The end platforms—which should have been abolished from subway and elevated service long ago as an obsolete survival of the early days of railroading—is omitted, and the whole 67-foot length of the car is available for seating accommodations. The width of the car is 10 feet. As compared with the present subway cars, the new model is 15 feet 7 inches longer and 15¼ inches wider. Each train will be made up of eight cars as against ten in the Interborough trains, and the total length of the eight-car train will be 538 feet 4 inches, as against 513 feet 5 inches. The total space in the eight-car train available for passengers is 4,711 square feet as against 3,702 square feet in the ten-car train.



Interior of car, showing seating and wide standing spaces.

In the Interborough cars there are a center door, and two end doors on the platforms; on the new car there is a center door, and a door at each side of it so spaced as to give the minimum amount of movement for a passenger in passing from his seat to the door or *vice versa*. The guard stands in the center of the car on the side opposite the station platform. He stands on a platform sufficiently elevated to enable him to see clearly each set of doors, which he opens and shuts by pressing electric buttons that operate an electro-pneumatic system. To prevent the motorman (every car is a motor car) from starting the train until every door is shut, the door-closing mechanism is so connected, electrically, with the controlling lever under the motorman's hand, that he cannot start the train until the last door in the train is closed, and an electric light signal in the cab has given him notification.

We draw attention to the accompanying table comparing the proposed car with the present subway car. The most significant comparison is that of the relative seating and standing capacity, from which it will be seen that the standing and seating conditions are vastly improved.

COMPARISON OF SEATING AND STANDING CAPACITY ON A BASIS OF 1,200 PEOPLE PER TRAIN.

	N. Y. Mun. Ry. Car.	Interboro Car.
Number of cars	8	10
Passengers per car	150	120
Pass. per car, seated	78	44
Pass. per car, standing	72	76
Standing space per car	370 sq. ft.	187 sq. ft.
Standing space per standing passenger	5 sq. ft.	2½ sq. ft.
Total seated on train	624 out of 1,200	440 out of 1,200

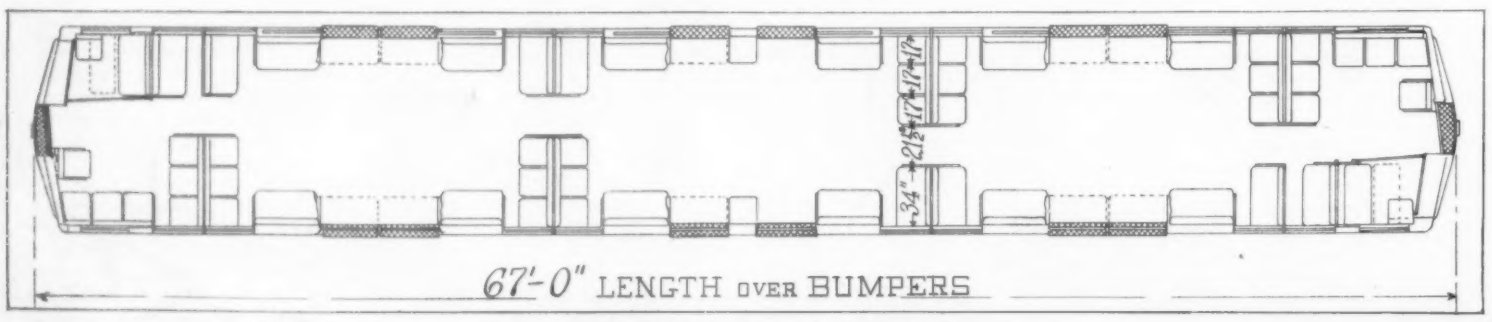


Diagram showing plan of seating and distribution of doors.

A New Mail Carrying Railway

A Parcels Post Tunnel

View of the inner circle, showing the tube at the far side and end, with a two hundred and twenty foot trestle on the right. The trestle represents a twenty per cent grade.

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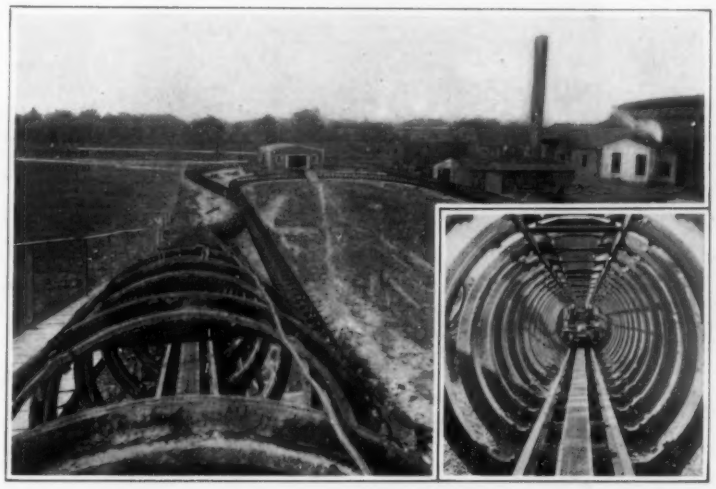

The structure viewed from the top of the trestle showing the terminal building in the distance.

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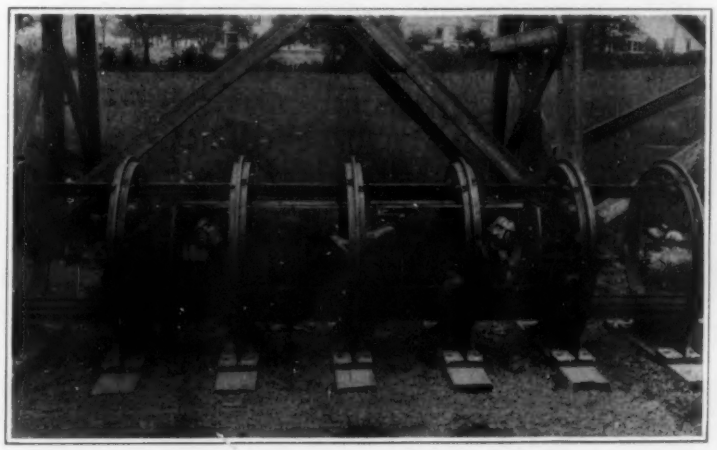

The car used in experiments.

The workmen were photographed inside the car to show the relative sizes of the parts. All the car space is available for freight. The cars weigh 1,200 pounds and take the grade easily with a ten per cent slip from synchronous speed under a load of 1,500 pounds.

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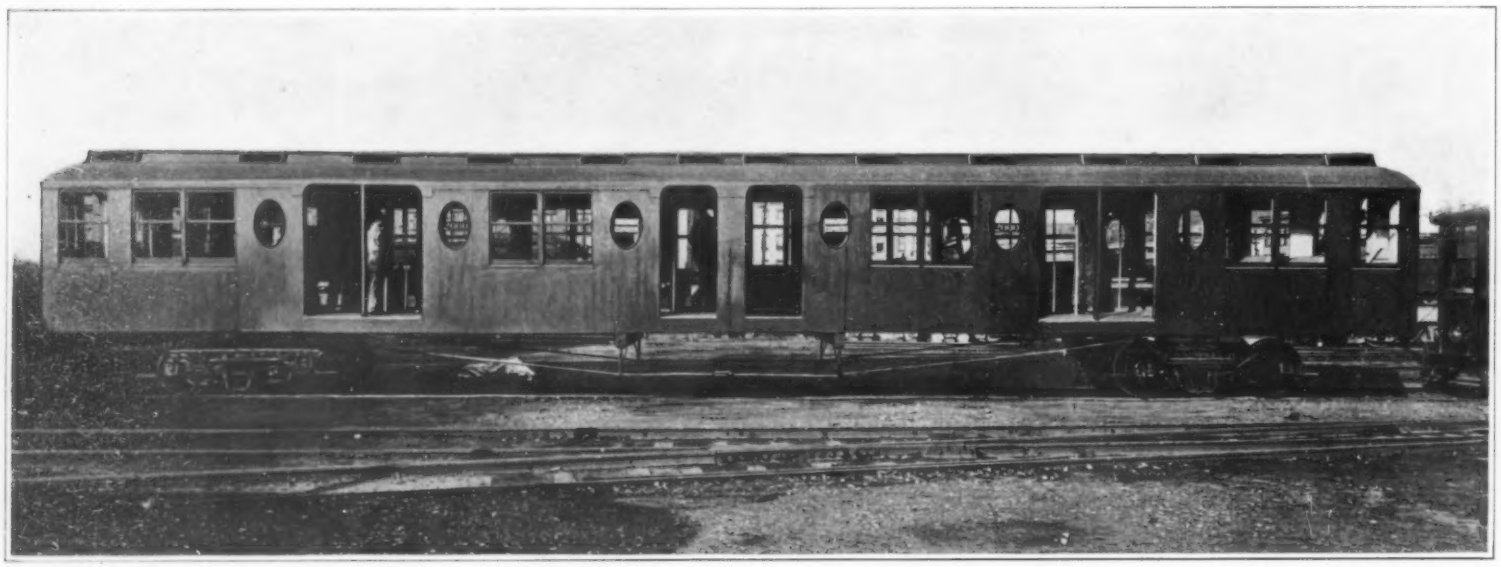
(Concluded on page 276.)

A Car Designed for the New Subway

Providing 42 Per Cent More Seats and 100 Per Cent More Standing Room Per Passenger



Full-size model in wood of new steel subway car for New York Municipal Railway Company.

IN rapid transit service, the number of passengers that can be carried in a given time over a given length of road is determined, not so much by the speed of the trains between stations as it is by the time occupied at the stations in discharging and taking on passengers. In most large cities, the rapid transit passenger asks first: that he be taken to his destination as quickly as possible; second: that he be given a seat.

On the present subway of this city, as operated by the Interborough Company, the express platforms are about five hundred feet in length. This dimension determines the number of cars that can be run in a single train; and the express trains as now made up consist of ten cars, which, if loaded to their maximum sitting and standing capacity, during the rush hours can each accommodate twelve hundred people—this, be it remembered, representing the maximum possible accommodation when there is heavy congestion of traffic. Of the hundred and twenty passengers crowded into each car, forty-four will be seated and seventy-six standing.

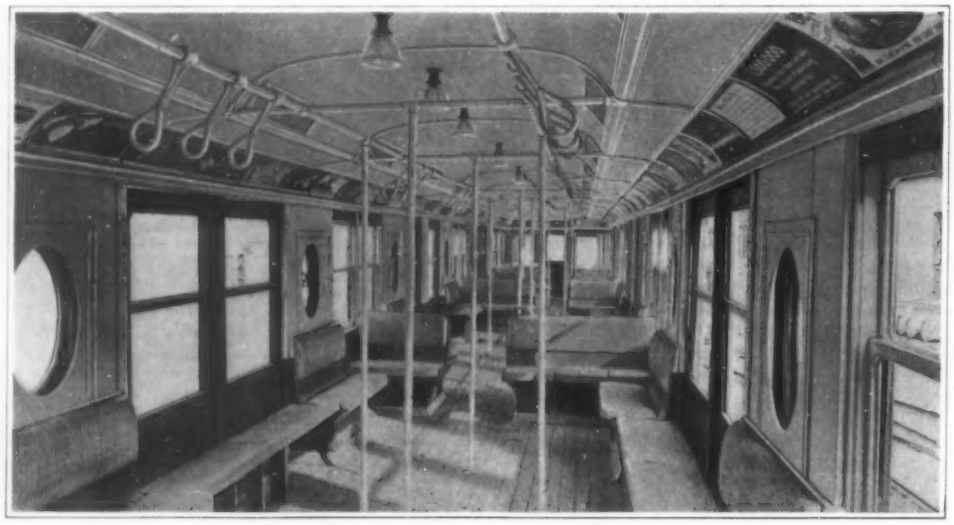
The New York Municipal Railway, which will operate a part of the new dual system that is under construction, has designed a new car, in which they have sought to provide, on the basis of 1,200 people per train, a larger seating capacity, and a less crowded standing space for those who cannot secure seats. Also, by making a better distribution of the three entrances to each car, they have facilitated the loading and unloading of passengers, and so have cut down the time of stopping at stations.

The new car will, of course, be built entirely of steel; but to demonstrate to the Public Service Commission and to those who are interested in the problem, the general external and interior appearance of the car, the comfort and convenience of the seating arrangements, and the freedom of ingress and egress, the company have built at their yards in Brooklyn a full-size model car, of which we present the accompanying illustration.

It will be noticed at once that the car is very much larger than those in use in the present subway. The end platforms—which should have been abolished from subway and elevated service long ago as an obsolete survival of the early days of railroading—is omitted, and the whole 67-foot length of the car is available for seating accommodations. The width of the car is 10 feet. As compared with the present subway cars, the new model is 15 feet 7 inches longer and 15¼ inches wider. Each train will be made up of eight cars as against ten in the Interborough trains, and the total length of the eight-car train will be 538 feet 4 inches, as against 513 feet 5 inches. The total space in the eight-car train available for passengers is 4,711 square feet as against 3,702 square feet in the ten-car train.

In the Interborough cars there are a center door, and two end doors on the platforms; on the new car there is a center door, and a door at each side of it so spaced as to give the minimum amount of movement for a passenger in passing from his seat to the door or *vice versa*. The guard stands in the center of the car on the side opposite the station platform. He stands on a platform sufficiently elevated to enable him to see clearly each set of doors, which he opens and shuts by pressing electric buttons that operate an electro-pneumatic system. To prevent the motorman (every car is a motor car) from starting the train until every door is shut, the door-closing mechanism is so connected, electrically, with the controlling lever under the motorman's hand, that he cannot start the train until the last door in the train is closed, and an electric light signal in the cab has given him notification.

We draw attention to the accompanying table comparing the proposed car with the present subway car. The most significant comparison is that of the relative seating and standing capacity, from which it will be seen that the standing and seating conditions are vastly improved.



Interior of car, showing seating and wide standing spaces.

COMPARISON OF SEATING AND STANDING CAPACITY ON A BASIS OF 1,200 PEOPLE PER TRAIN.

	N. Y. Mun. Ry. Car.	Interboro Car.
Number of cars	8	10
Passengers per car	150	120
Pass. per car, seated	78	44
Pass. per car, standing	72	76
Standing space per car	370 sq. ft.	187 sq. ft.
Standing space per standing passenger	5 sq. ft.	2½ sq. ft.
Total seated on train	624 out of 1,200	440 out of 1,200

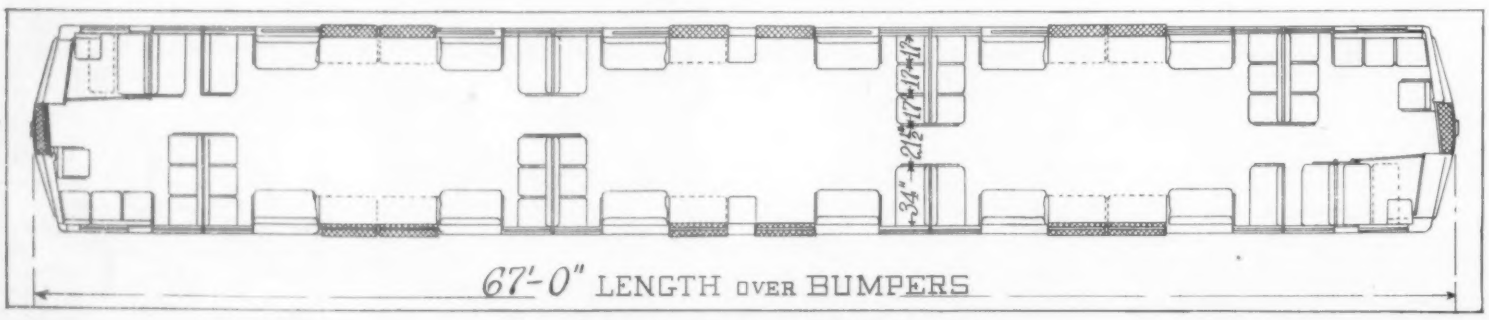


Diagram showing plan of seating and distribution of doors.

A New Mail Carrying Railway

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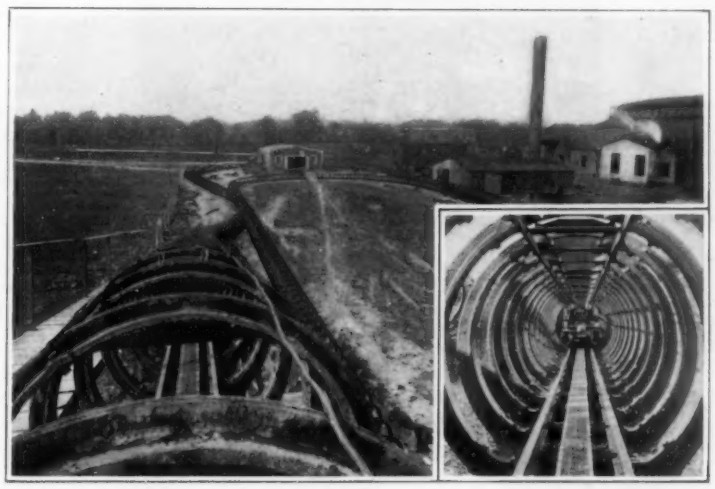

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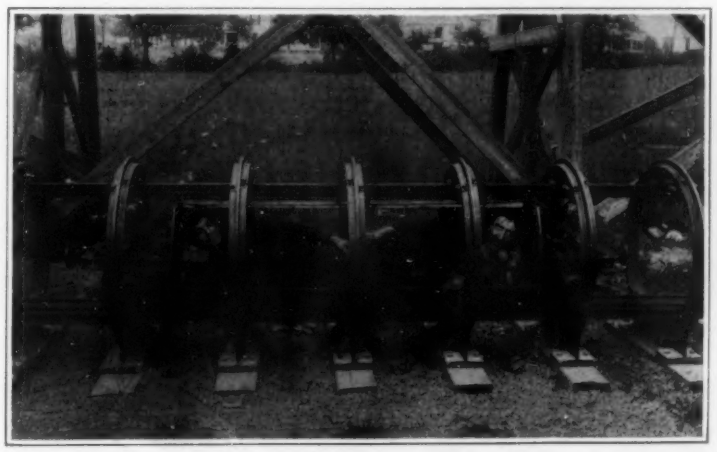

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The Heavens in October

The Newly Discovered Comets and Their Orbits

By Henry Norris Russell, Ph.D.

AFTER a considerable interval, during which no comets appeared, two have been found within a few days of one another.

The first was discovered by the Rev. J. H. Metcalf, at South Hero, Vermont, on the night of September 1st—evidently while this well known and successful astronomer was enjoying his vacation. It appeared to be of the ninth magnitude, and showed a slow northerly motion. The discovery was, as usual, telegraphed to Harvard, whence the news was spread to astronomers generally.

A photograph taken at the Yerkes Observatory by Prof. Barnard, on September 5th, with four hours' exposure, showed the comet as a round, condensed nebulosity without any tail.

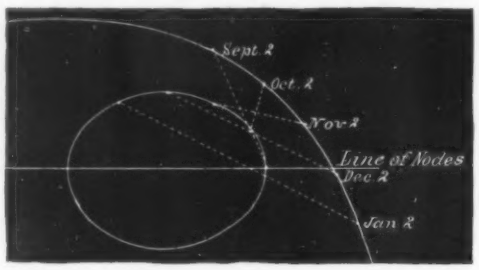
A provisional orbit of this comet, based on observations on September 2nd, 3rd and 4th, shows that it was just approaching perihelion when discovered, and reached that point in its orbit on September 14th, at a distance of 122 million miles from the Sun. The plane of its orbit is inclined about 37 degrees to that of the ecliptic, and its motion around the Sun is retrograde; that is, in the opposite direction to that of the Earth.

The second comet was discovered by the Russian astronomer, Neujmin, four days after the first. Its orbit has also been calculated, and it appears that it, too, was just approaching perihelion when discovered, and will be nearest the Sun on October 3rd. The parabolic orbit first calculated gave the rather large perihelion distance of 160 million miles; but the computers, Einarsson and Nicholson of the University of California, state that the observations can only be satisfactorily represented on the assumption that the orbit is an ellipse, with a period not exceeding 18 years, in which case the perihelion distance comes out 143 million miles. As the inclination of the orbit is only 20 degrees, and the comet's motion is "direct," it is not unlikely that it may prove to have a short period, for the orbits of all the known short-period comets show these characteristics. This cannot be settled, however, until the comet has been under observation for a month or two.

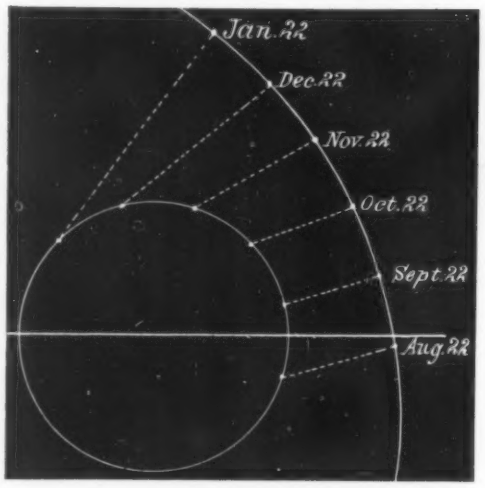
As is usually the case, the ephemerides of the comets' motions which have so far been published "run out" before the date at which these words will be published. In the case of Neujmin's comet, whose apparent motion is nearly uniform, the ephemeris can easily enough be extended, showing that on October 1st it will be nearly in 23 hours 33 minutes right ascension, and 9 degrees north declination, and will be moving 45 seconds westward and 28 minutes northward per day. This comet should then be a little brighter than at the time of discovery; but as it was then of magnitude 11.5 it will not be at all conspicuous, even in a telescope of moderate size.

Metcalf's comet has been rapidly approaching the Earth during the last few weeks, and its apparent motion in the heavens has been at a steadily increasing rate. This makes it more difficult to extrapolate its position beyond the end of the published ephemeris; but it can at least be said that at the beginning of October the comet will be in Cepheus, in about 1 hour 20 minutes right ascension and 79 degrees north declination. On October 3rd it should be close to γ Cephei, and moving in the direction of α Cephei, at the rate of fully 2 degrees a day. At this time it will be about as near the Earth as it will ever get—some 54 million miles away—and should appear a little fainter than the seventh magnitude, conspicuous in a small telescope, and visible with a good field-glass.

The two accompanying sketches show the orbits of these comets. In the case of Neujmin's comet, the plane of the orbit is near enough to that of the Earth's orbit to permit both to be drawn "in plan" without serious error. If the Earth's orbit is supposed to be exactly in the plane of the paper the comet's orbit must be imagined to rise slightly above this at the upper part of the figure, and to pass below the paper in the lower part, crossing the surface where it cuts the "line of nodes." The positions of the Earth and comet at intervals of a month are shown, connected by dotted lines. At the last date represented (January 22nd, 1914) the distance of the comet above the plane of the paper is about half the radius of the Earth's orbit. It will easily be seen how the comet will remain visible for several months, at first remaining in almost the same longitude (referred to the ecliptic), but slowly moving northward in the sky, and varying very little in distance from the Earth or in brightness; and that later it will retrograde in longitude, recede from the Earth, and grow fainter, but will remain visible in the evening sky for many months. In the case of Metcalf's comet, the inclination of the orbit is much greater, and one diagram shows the comet's orbit in plan, but the Earth's orbit is seen obliquely and foreshortened from a circle into an ellipse whose upper side must be supposed to be behind the plane of the paper. Here, on account of the retrograde motion of the comet, the circumstances are very different. The two bodies approach one another very rapidly during September, pass one another early in October, and recede from one another with almost equal speed, so that by December 1st they will be about 180 million miles apart.



Orbit of Metcalf's comet.



Orbit of Neujmin's comet.

The comet's apparent motion, in consequence of this, was slow when first discovered, since it was coming nearly straight toward us; increased very rapidly, reaching a maximum early in October, and will then quickly fall off again, while its brightness varies in just the same way. It may finally be observed that both of these comets have happened to present themselves under almost the most favorable conditions for observation, passing the points where their orbits come nearest to that of the Earth at almost the same time that the Earth reached the corresponding points of its own path.

If Neujmin's comet had come to perihelion six months earlier or later, when the Earth was on the opposite side of its orbit, it would have been fully 250 million miles from the Earth, and almost behind the Sun, and it would have almost certainly escaped discovery. Metcalf's comet, on account of its retrograde motion, would have stood a better chance of discovery, but would not have been nearly as bright as it will actually appear.

The Heavens.

Our map shows the aspect of the evening skies so well that little description is necessary. The Great Bear is low on the northern horizon, with the Dragon and the Little Bear above. Hercules is setting in the northwest, with Lyra and Cygnus at a higher altitude, and Aquila farther to the south. Pegasus is just south of the zenith. Below it, Eridanus, Cetus, Aquarius and Capricornus fill a vast dull region, sweeping right across the heavens from east to west, in which the only conspicuous stars are β Ceti and (farther south) Fomalhaut in the Southern Fish.

The eastern sky is far more brilliant. Aries and Taurus are high above the horizon, when Orion is rising, and in the northeast we find Andromeda close to the zenith, then Perseus and Auriga, while Gemini is beginning to appear.

Metcalf's comet is in Cepheus, above the Pole, and Neujmin's is a little south of the lower edge of the great square of Pegasus, so that both are excellently placed for observation.

The Planets.

Mercury is an evening star throughout October, but is very far south, and hard to see. He may perhaps be picked up near the end of the month, when he sets about 5:50 P. M., but even this is only 55 minutes after sunset. Venus is a morning star in Leo and Virgo, rising at 3:20 A. M. on the 1st and 4:25 on the 31st. The change in her appearance is mainly due to her southward motion, but partly to her diminished distance from the Sun. Telescopically, she appears gibbous, like the Moon three or four days from the full. Mars is in Gemini, moving slowly eastward, and steadily growing brighter. He is in quadrature with the Sun on the 2nd, and crosses the meridian at 6 A. M., but being so far north he rises long before midnight; in fact, by half-past 10. At the end of the month he rises about 9:30, and is conspicuous in the latter part of the evening, looking as bright as Capella or Saturn. Jupiter is evening star in Sagittarius and passes through quadrature on the 2nd. Being very far south, he sets at 10:30 P. M. at the beginning of the month and 8:50 at its close. Saturn is in the eastern part of Taurus, and rises about 8:15 P. M. in the middle of the month. Uranus is in Capricornus, and crosses the meridian about 7 P. M. Neptune is on the border of Gemini and Cancer, and souths about 6:30 A. M. The Moon is in her first quarter at 9 P. M. on the 6th, full at 1 A. M. on the 15th, in her last quarter at 6 P. M. on the 22nd, and new at 10 A. M. on the 28th. She is nearest the Earth on the 28th, and farthest away on the 12th. She is in conjunction with Jupiter on the 6th; Uranus, the 8th; Saturn, 19th; Mars, 21st; Neptune, 22nd; Venus, 27th; and Mercury, 31st.

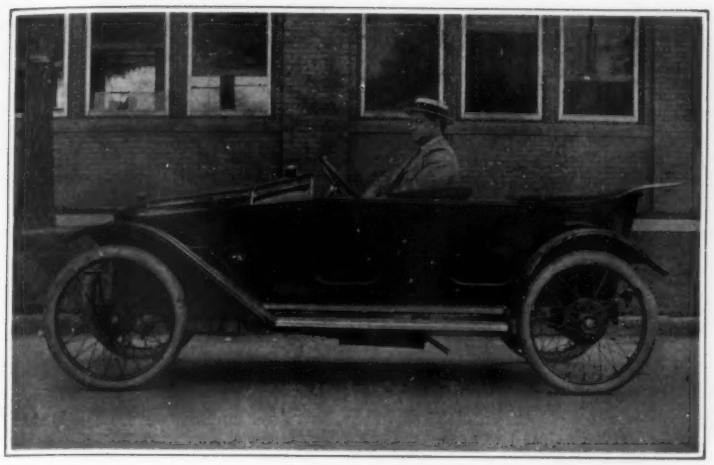
Princeton University Observatory.

At 11 o'clock : Oct. 7.
At 10½ o'clock : Oct. 14.
At 10 o'clock : Oct. 22.

At 9½ o'clock : October 30.

At 9 o'clock : Nov. 7.
At 8½ o'clock : Nov. 16.
At 8 o'clock : Nov. 23.

NIGHT SKY: OCTOBER AND NOVEMBER.



Cyclecar product of an American automobile manufacturer.

One of the newer American cyclecars.

Cyclecars—American and Foreign

An Automobile That Developed from the Motorcycle

IN England, and, to a lesser degree, in France and Germany, automobile circles are taking a lively interest in the "cyclecar." These little vehicles are neither real automobiles in the usual sense of the word nor motorcycles. Americans, too, have developed cyclecars of their own, or vehicles so closely akin to the typical cyclecar that they must be classed as such.

In the broadest possible sense, the American cyclecars might be classed as imitations of the foreign style. Actually, however, they are not imitations. They are original vehicles, brought out to fill in America the place that is filled abroad by the foreign cyclecar. Hence, it was to be expected, in foreseeing their ultimate development, that there would be vital differences between the American and the foreign cars.

Undoubtedly it was the motorcycle that furnished the inspiration for the cyclecar. Most mortorcycles will carry two persons, but hardly in comfort. Hence, to carry two persons in comfort required some other arrangement, and because of the difficulty of constructing side cars that will stand up and that look well and afford real protection to the second passenger, as well as to the first, the cyclecar was naturally evolved.

And, quite as naturally, the typical foreign cyclecar is characteristic of the latest motorcycle whence it sprang. It is true that some of the foreign so-called cyclecars are perilously like full-fledged automobiles in everything else but size.

It is therefore apparent that there are few restrictions to bind the designer of a cyclecar, and yet the restrictions are sufficient to make necessary the elimination of parts that characterize the full-sized automobile. Thus, the typical foreign cyclecar is minus the usual differential mechanism and live rear axle, and as a rule has no change gear set. In these two respects the American cyclecar, or the American vehicle that comes as near to being a cyclecar as is possible with proper construction, is quite different from its foreign cousin. In every one of four American cyclecars on the market at present there is a change gear set, shaft drive, live rear axle and a differential mechanism, all of which parts belong to the ordinary motor car. Hence, whereas the foreign cyclecar is a thing apart, the American cyclecar is nothing more or less than a miniature edition of a full-sized automobile.

In the design of the typical foreign cyclecar the motorcycle motor, designed and built for the motorcycle, is adopted in toto without any excuse and with less alteration. As a rule, it is a twin-cylinder air-cooled motor. In every one of the four American cyclecars to which we have referred, however, the motor is a four-cylinder machine and is cooled by water. All of them, except one, are block-cast machines with poppet-valves, and the one exception has a piston-valve motor. Among twenty-two makes of well known foreign cyclecars, on the other hand, only two have four-cylinder, water-cooled motors, whereas eleven have two-cylinder, air-cooled motors, two have single-cylinder, air-cooled motors, and seven have two-cylinder water-cooled motors. The resemblance to motorcycle practice is unmistakable.

In the transmission elements of the twenty-two foreign cyclecars, the resemblance to motorcycle construction is even more apparent. Seven of them are driven by means of belts to the rear wheels; of these seven, six have chain transmission from the engine to a countershaft; three of them are driven directly by chains and the remainder have shaft drive to either bevel or worm gearing on the rear axle. In the four American cyclecars which we have studied we find that every one has shaft-drive through a three-speed gearset to a differential-bevel driven rear axle. The American cars, therefore, are much more closely allied to their larger brothers of the automobile world than are the foreign cyclecars.

If we examine the sixteen cyclecars representing England, France and Germany that ran in the Automobile Club of France's Grand Prix race for cyclecars a few weeks since we discover that no less than nine of them were driven by belt, and of these nine six had chain drive to a countershaft; the remaining three out of the nine had, in two cases, shaft drive to the countershaft, and in the third case—the "Bedelia"—the drive was direct from the engine to the road wheels by belt. These little machines are very obviously nothing more than enlarged motorcycles.

Still further examination of these foreign cyclecars shows that in a great many cases the steering gear consists of nothing more complicated than a couple of steel cables running over a drum on the lower end of the steering column. Six of the cyclecars in the Grand Prix race were so controlled. American practice, however, prescribes the regulation worm and sector gear found on full-sized automobiles. Again, the tread, or wheel track of the typical foreign cyclecar is narrower than the standard fifty-six inches adhered to by the makers of large motor cars. The tread of two of the American cyclecars measures thirty-seven and forty-four inches, respectively; of the other two, fifty-six inches. The average wheelbase of the foreign cyclecar is approximately eighty-eight inches, and the average wheelbase of the four American cyclecars is ninety-four inches; the average weight of the foreign cyclecar is a little over six hundred and ten pounds, and the average weight of the four American cars is nearer to eight hundred pounds.

Before going any further it is necessary to call attention to the fact, if that fact has not already been discovered, that the four American cars which have been partially described, are not, strictly speaking, cyclecars.

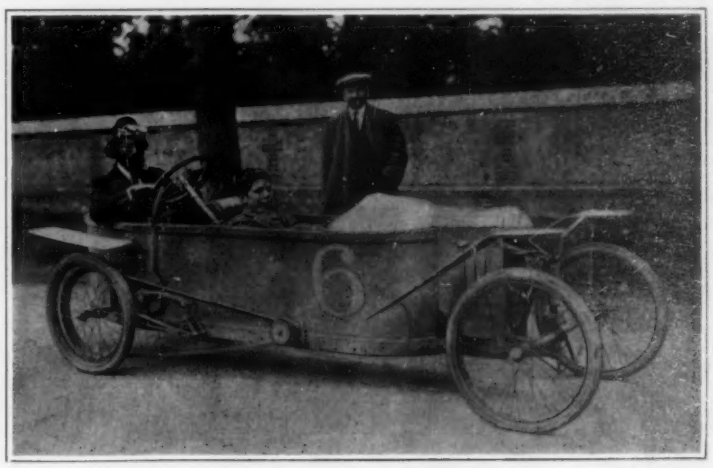
But they are small cars—very small ones—and they are the nearest approach to the true cyclecar that has as yet been produced for the market in America. Consequently, as such, they are interesting.

If they are considered as real cyclecars, they are easily the superior of the average foreign cyclecar, which in the language of a well known British engineer who recently paid a visit to the United States, "is poorly designed and improperly constructed with too little attention paid to detail and to the strength of parts."

Just how far short of their ideals foreign manufacturers of cyclecars have fallen is well indicated by the list prices that are quoted for these little vehicles. Despite the light construction, the adoption of existing motors and the incorporation of motorcycle features, all of which logically should be expected to lower production cost and hence selling price, the foreign £100 cyclecar is still practically unknown; and it was the £100 cyclecar that designers first sought, and, be it added, still are seeking.

In the mean time, American designers have bestirred themselves and actually *have produced* the $500 cyclecar. In two cases that figure includes a reasonable amount of equipment, which is never included under foreign selling prices. Starting virtually at the bottom, with little but the germ of the cyclecar idea, American designers have cast out motorcycle practice as unsuitable and have built their cyclecars from the bottom up. As a result they may be styled, without any fear of contradiction, able little cars capable of standing up under hard service.

German type of the cyclecar.



A French cyclecar of the tandem type.

Interesting Uses of Paper

IT is a question whether there is an industry in this country more interesting than the manufacture of wood pulp and its many uses. A number of countries have contended for the honor of enjoying greatest progress in the making of various articles from wood pulp. Germany, France, England, and the United States are the principal claimants. Of the four countries named, Germany would seem to have the balance of testimony on its side. Novelties made from paper pulp are by no means of rare occurrence in the United States, and are now so multifarious as to defy enumeration.

At first, wood pulp was used entirely in making paper, but to-day it is employed for manifold purposes. Its use bids fair to be large for moldings, friction clutches, belt-pulleys, gear wheels, barrels (reinforced with wire), tubs, pails, washboards, water pipes, conduits, caskets, bath tubs, carriage bodies, floor covering, electric insulators, umbrella stands, furniture, imitation of leather, cloth, and silk. Clearly the employment of wood pulp is practically unlimited.

The great consumers of wood pulp to-day are the paper manufacturers who use nearly 90 per cent of the entire production. According to the Bureau of Statistics, there are at present about 250 mills which manufacture wood pulp in this country. The capacity of these mills is over 2,500,000 tons of pulp annually, valued at more than $32,000,000. In addition to this amount, more than 400,000 tons are imported from Canada and various countries of Europe. The value of the material received from abroad in 1911 was nearly $15,000,000. These figures show an increase in the business of over five hundred per cent in the past ten years, and the same time in the future promises even greater strides.

By proper treatment wood pulp can be made perfectly translucent, unbreakable, and indifferent to atmospheric changes. While it has not yet been made transparent, it admits abundant, soft, pleasant light, where it is used in place of window panes. Paper pulp is now made up into boards that can be used in a variety of places to supplant the use of wood. The ease of molding into any desired shape and the saving in weight make the use of this product valuable in construction of the ornamentation of ships such as the facing and frames of doors, wainscotings, panels, etc. This material is also used in making imitation tiling for the walls of bathrooms, the forming of closet seats, etc. In fact, entire houses, garages, henroops, etc., have successfully been made of this paper board. When properly impregnated it is impervious to moisture and forms a good non-conductor of heat. Another product used in house construction is roofing tiles, which are now gaining a reputation for their superior qualities over other roofing material in the market. The application of wood pulp for house building is not new, and has met with complete success. In Europe there are some firms which build houses almost entirely of waterproofed pasteboard. Wood pulp is likewise used instead of wood for making furniture, tables and folding chairs, their chief advantages being lightness.

Paper screws are now being made which give thorough satisfaction. The principle of having wood against wood is a point in favor of wood screws. They are used for ornamental work, where it is desirable to give the heads of the screws the same color and grain effect as wood. A varnish on top of this adds to the effect and protects the dye, as it penetrates the fiber and acts as a preservative. It has been estimated that these wood pulp screws can be made so cheaply as to compete successfully with screws and log bolts of other types. Paper screws can be readily removed even after they have been in place for many years. The screws are cast and the thread is cut as in the common wood screws. The drive screw is cast with attenuated thread curves, so that when driven it revolves and finds a firm footing in the wood. It can be driven only into soft wood after a hole is first started.

Another economic application of paper which is gaining in importance is the making of cord and rope. These new ropes are spun and twisted out of the thin threads which are made from wood pulp. This industry has attained considerable importance in Europe. It is said that these ligneous fiber ropes are used more or less extensively in the foundries of Germany. The fine threads which make up these ropes are made by forcing the chemically treated wood pulp or cellulose through very fine tubes into running water, in which they harden. After they are dry they are perfectly pliable and somewhat elastic, and may be spun or twisted into any form whatsoever. These minute, elongated threads are caught up as they are forced through the fine tubes and spun into ordinary silken threads, which are woven into a fabric resembling silk.

A French inventor discovered that paper may be cut into narrow strips several millimeters wide and that after these have been steeped in certain chemicals which give them tenacity and ductility, they may be rolled and twisted into threads, which may be worked up into fabrics of various kinds and put to a great variety of uses. Another French chemist has discovered a way to make such fabrics, as well as ordinary paper, waterproof, and a German inventor has produced a good quality of thin paper practically fireproof.

Such discoveries have led to the making of hats, raincoats, corsets, vests, underwear, collars, ties, socks, shoes and even overshoes. In the Chicago City Hospital experiments have been made in furnishing the patients with garments made of a soft tough paper. These garments are light and airy. After use each garment is destroyed and thus all danger of infection is avoided. The paper raincoat is a novelty. It is made of a light-weight waterproof paper. The garment comes folded in a very small package which can easily be put into a lady's handbag. The package is opened and the coat unfolded as occasion demands. The article is so cheap that it can be thrown away after use. One inventor has designed a paper sock for use in the army. The sock covers only the parts of the foot that are usually chafed by the shoe. This insures light weight and adds greatly to the comfort of the wearer.

Paper may even be so treated as to make it suitable for sails for light vessels. Such sails are not woven from strands or threads, but are made up from compressed sheets of paper, which are made in the regular way, the pulp having been thoroughly mixed with certain chemicals and other substances. These paper sails are inexpensive compared with good canvas stock or rubber material.

But by far the greatest progress has been made in the application of this material to sanitary and domestic uses. The realization by the public generally of the germ theory of disease has done more to multiply the uses of paper than any other factor. It has led to the introduction of the various individual receptacles and containers that now appear upon the market. Notable among these is the individual drinking cup. The extent to which these cups are utilized can be comprehended when it is stated that the returns realized from the sale of penny cups from slot machines in the Pennsylvania State capitol building alone amounted to $113 during the past year.

In modern sanitation and the treatment of diseases the various paper receptacles and protective appliances have proven of inestimable value. In some of the western States, notably California and Colorado, which furnish a climate especially beneficial in the treatment of tuberculosis, it has become imperative for all public articles to be thoroughly protected. Otherwise contagious diseases will be spread instead of checked. Some of the most dangerous articles are the telephone mouthpiece, the common towel, and the public drinking cup. Paper has come to the rescue and supplied towels and drinking cups that are to be discarded after use.

Milk bottles of paper will soon be in extensive use. They are cheap and sanitary and the troublesome washing and collection of the empty bottles is obviated. The danger of breakage is also eliminated. A very recent improvement in paper milk bottles appears in a patent to A. G. Brant (No. 1,067,237). This is a bottle having a narrow strip of transparent material running the full length of the side. This allows the buyer to see the level of the cream on the milk or the level of the liquid in the interior, and enables him to tell whether there is any sediment in the bottom of the bottle.

Paper receptacles of all kinds are now on the market. These are especially valuable in the packing and shipping of foodstuffs. The manufacture of water- and grease-proof paper has recently been introduced and is especially useful in this connection. Eggs are best packed in paper receptacles, and a recent practice has arisen of shipping eggs by parcels post in a special type of paper container. Ice cream is at present sold in small quantities, packed in paper receptacles, and it has become a practice for some of the progressive dealers to furnish therewith cheap paper spoons that cost very little.

The packing of loaves of bread in individual wrappers is another advance in the handling of foodstuffs, an advance which not only insures cleanliness, but also prevents the entry and escape of moisture and preserves the freshness of the loaf.

One inventor, J. W. Weiss (No. 1,063,845), makes a collapsible box of paper with a reinforced part along the sides or corners. Usually collapsible paper boxes are very flimsy, but this box is strong enough to bear the weight of a full-grown man. The immensity of the paper box industry may be realized when it is stated that in one industry alone—the manufacture of pens, pencils, and erasers—over four thousand different sizes and shapes of boxes are required.

But the use of paper in this country cannot approach the many uses to which it is put in Japan, which is virtually a paper kingdom. The houses are made of thin, light frames of bamboo covered with paper. Almost everything that the Americans make of wood or leather is there made of paper. The coolies wear mantles in rainy or snowy weather made of a very tough grade of waterproof paper. These mantles can be used continually for about a year and cost only 18 cents. The tea merchants use paper sacks, the paper having been tanned by a vegetable acid. These sacks are used over and over again, and it is said to be a common thing to see sacks that are eight or ten years old and have paper patches on them.

The Wreck of the First German Naval Airship "L 1"

By Carl Dienstbach

THE Zeppelin "L 1," the first attempt to adapt a dirigible to regular sea service with the navy, foundered in a heavy storm on the North Sea with great loss of life, twenty nautical miles to the northwest of Heligoland, late in the afternoon of September 9th. It left the air harbor of Hamburg at 1:30 P. M. in bright sunshine to take part in the night maneuvers of the navy, with supplies and a crew for a thirty-hour trip. The ship had been in service for nearly one year, making more frequent trips than any airship of the army, and it had been found desirable to equip it with a heavier and more powerful wireless telegraph, a stronger electric searchlight (big arc lamp worked by heavy storage batteries), with a sound-proof cabin for the wireless apparatus, with an upper platform accommodating two machine guns in place of one; all being an additional load, for which the ship's original carrying capacity was not quite sufficient. It meant that at the start of a long trip with great quantities of supplies, and with a numerous crew, on duty in two shifts or "watches," the surplus lift for emergencies was smaller than originally provided for. The ship had been built with a greater displacement than the old type for over-sea use. Its unfortunate commander, who, like a naval captain, did not survive his ship, is known to have privately stated, from experience, that the changes had made it too heavy, and that it might plunge down some day.

The eagerness of the naval authorities to test and develop military equipment, and the fact that even so, only the extra amount of buoyancy provided for over-sea use had been sacrificed, and what on a smaller "overland" dirigible would have appeared a fair amount of ballast could still be carried, is responsible for this peculiar situation, which, through an unusual combination of circumstances, was eventually bound to bring disaster.

On the day of the wreck the "L 1" started fully inflated, but in bright sunshine, losing immediately gas by expansion. As soon as the sea was reached the sun disappeared and it began to rain. The gas shrank and the hull became heavy with moisture.

Behind Heligoland the airship was struck by the first real sea storm ever encountered by any aircraft. It was one of the typical fierce storms on the North Sea, which at this time of the year, according to Capt. Blew of the airship "Victoria Luise," formerly a naval officer and very familiar with the German Ocean, mostly prevail at the latitude of Norway, but may without warning extend farther south. The rain squalls became of tropical violence and vertical gusts threw the airship up and down nearly a thousand feet at a time. The cooling of the gas became so intense, and the hull so heavy with the water streaming from its sides, not to mention the downward momentum of the impinging tropical rain, that Dr. Eckener, the experienced pilot of Zeppelin dirigibles, figures a loss of buoyancy that meant the sacrifice not only of all the available ballast—the gasoline, unfortunately, could not be quickly discharged—but also all the aeroplane lift of the hull and the propellers. This left nothing with which to counteract the vertical gusts. When it was tried to "beach" the airship by running at top speed before the wind, the effect of the vertical gusts (according to Capt. Blew's experience in running before the wind) increased so much that the ship became their toy. With the heavy storage battery screwed to the front car, and very probably a rush of the crew at the last moment for the life-preservers, most of which were kept there, the vertical rudder could not prevent it quickly enough from striking the raging sea head on while traveling at a terrific speed, thus burying and crushing the bows and stunning every man in front. The hull crashed down on the car. The waves made such short work of the hull that every single gas compartment was soon torn by the broken aluminium frame. The wreckage went down in forty minutes. The storm, which lasted all night, was so bad that the fishing steamer "Orion" ran great risk trying to save some of the crew.

The new naval airship just completed is provided not only with great surplus lift and much higher speed and controlling power, but is also stouter and shorter, thus exposing proportionally less surface to the rain. It is needless to say that any other type of aircraft would have shared the fate of "L 1" under like conditions.

An Emergency Dark Room

A "DARK ROOM" which has once served to make a safe change of plates in the holders, and which may serve again, is herewith illustrated. The arms of the operator were thrust through the sleeves of the largest available raincoat, from the outer ends inward; then the neck of the coat was drawn closely around his body while the edges and bottom were held under his feet and legs. Though such a dark room is adapted, literally, to serve only "on a pinch" it gives sufficient room to empty and refill one or two plate-holders at a time. One can readily tell, by a touch of the finger tips, which is the emulsified side of a plate; and if the covers are put in wrong side out the error is easily corrected by placing the holder in the camera with the shutter closed.

Changing plates in a raincoat.

Buttresses of an elm tree.

The Largest Ice Cave in the World

A FEW years ago some members of the Austrian Speleological Society discovered in the Dachstein mountains some caverns which are among the largest in Europe. One of these grottoes, the longitudinal axis of which is fully 6,500 feet long, moreover turned out to offer additional interest by its truly enormous ice masses and was found to be the largest known ice cave in the world.

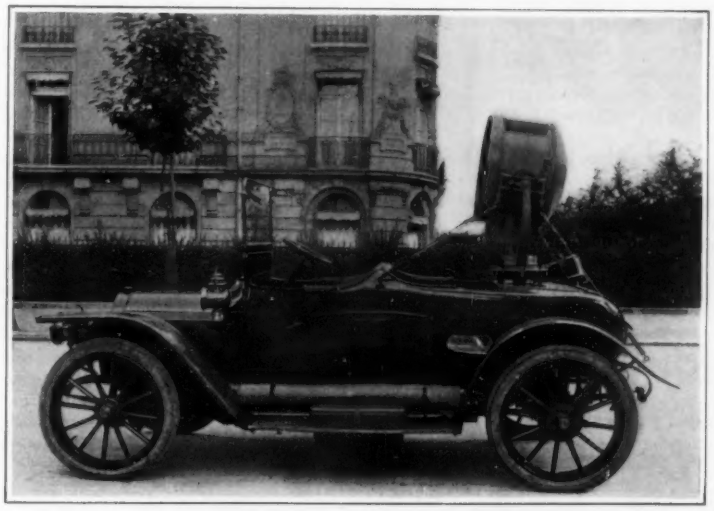
Though a scorching sun may be burning outside on the bare mountain rock, there is always an icy wind blowing through this underworld, freezing everything within its reach. Only sometimes, when the outside temperature ranges between 32 and 41 deg. Cent., and a comparatively warm rain pentrates through the fissures of the rock, entering right into the cavern, will there be a temporary calm and distinct melting of the ice.

The Dachstein ice cave comprises several domes filled with ice, which communicate with one another through a number of frozen galleries. An ice crevice 89 feet deep and 116 feet in width traverses the floor of the cavern 165 feet from the entrance. Gigantic ice pillars were found to tower on both edges of this chasm, in the depth of which there unfolds a fairy-like ice scenery. Beyond the abyss the cavern widens out into a mighty dome ("Tristan Dome" as it is called), where a plain ice sheet reaches from one wall to the other, carrying ice stalagmites of the most fantastic shapes. This hall is continued in a gallery through which flows an ice river. A hall of imposing dimensions (396 feet in length, 231 feet in width and 116 feet in height), called "Parsival Dome," is next entered quite abruptly, which exhibits an immense variety of ice formations of every description. The descent to the bottom of the cave is made over an ice river, known as Montsalvasch Glacier. At the foot of the glacier a lake of ice spreads from end to end of the hall, carrying ice stalagmites of animal likeness. Over an ice wall 50 feet deep and through a portal formed by huge ice arches, access may be had to the second part of this underground world. This is distinguished from the former by a considerably higher temperature, preventing the formation of ice. Tremendous rocky deserts with an enormous chaos of boulders here take the place of greenish shining ice domes. The largest room is "King Arthur's Dome," a practically central hall, 660 feet long, 330 wide and 100 feet high. Its huge side galleries contain, in addition to stalagmites of cauliflower shape, an enormous mass of crystalline erratic blocks brought down to these depths from the Central Alps by the underground rivers of an early geological period.

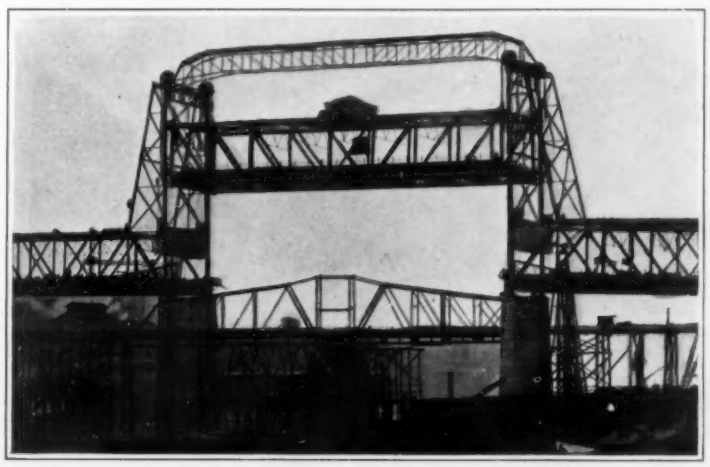
The Dachstein cavern; Parsival Dome, showing the ice lake.

A Bridge Within a Bridge

A NEW $600,000 steel bridge has been built by Tacoma over the bay to open up the tide flats to industrial concerns. While the new bridge was being built, the old bridge remained in service and the accompanying photograph shows the two bridges, one above the other, the old bridge not yet removed at the time the picture was taken. The new bridge clears the water at high tide by 60 feet, while the lift span when raised provides a clearance of 135 feet, the highest point of the structure being 175 feet above the water. The vertical lift weighs 800 tons and is supported by two 400-ton concrete counterweights. The lift is raised and lowered by electricity. The bridge, including wooden approaches, has a total length of 3,000 feet, of which 2,100 feet is of steel. The lift span is 220 feet long and 70 feet wide, providing a roadway 50 feet wide with sidewalks ten feet wide on each side.



Automobile searchlight for the French army.



New vertical lift bridge built over a swing draw.

A Curious Elm Tree in Florida

THE accompanying photograph shows the base of an elm tree, which was standing on the banks of the Oklawaha, near Silver Springs, Florida. The interesting features of this tree, well illustrated in the photograph, are the high buttress roots at the base of the trunk. These buttresses are plank-like outgrowths not more than an inch or two thick, extending 6 or 8 feet outward, and about 5 feet upward along the stem. These acted as stays or props to preserve the upright position of the tree, which grows in wet shallow soil underlaid with hardpan. They are a common occurrence in many tropical trees, which, as a rule, have tall straight trunks, with the branches and leaves only at the top, and, therefore, require some support as is offered by these buttress roots. Such "spurs," as they are often called, are commonly seen in large mahogany, Spanish cedar, and ceiba trees in tropical America, but it is very unusual to find trees from the temperate climate with such pronounced buttress development. This curious elm tree was found a number of years ago, but recently it had to be cut down on account of certain improvements. The stump was dug up and removed to a more accessible place, for the benefit of the many tourists who visit Silver Springs.

Automobile Searchlight for the French Army

DURING the maneuvers of the French Army in the Southwest, which began on September 17th, a searchlight automobile was used; that is, an automobile with a powerful searchlight suitably mounted at the rear of the body. The swivel standard of the searchlight is clamped to a plate which is yieldingly supported between coil springs carried on bolts. This prevents jars from being communicated to the searchlight when the machine is in motion. To steady the searchlight while in transit, it is held by four guy cables, the two forward ones being attached to coil springs so as to absorb shocks. The searchlight will project a powerful beam to a distance of three kilometers (1.86 miles). The automobile carries a tripod on which the standard of the searchlight may be clamped at a moment's notice when desired.

The Pseudo-language of Monkeys

CONCERNING the supposed language of anthropoid apes, Prof. Boutan has recently taken up the question and arrives at a negative result. It will be remembered that Dr. Garnier came to the conclusion that monkeys have a language analogous to human language and express themselves by signs as well as by sounds which they emit. According to Prof. Boutan, there is only a difference of degree between this and human speech and not one of kind. He observed the sounds made by a gibbon which he had captured when young, and his experiments cover more than five years. He finds that the animal can produce only spontaneous and instinctive sounds corresponding to a state of satisfaction or the like, or again to a state of uneasiness or fear; also great excitement, and the sounds do not appear to correspond to a real language, but rather to what he calls "pseudo-language." While sounds of real language are acquired by education, those of pseudo-language are purely spontaneous, and he thus differs from Dr. Garnier's conclusions.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

A New Type of Spiral Gear Differential

OF the many parts of the motor vehicle, it is doubtful if any has been given less attention than the differential mechanism. The device is palpably imperfect and long has been viewed in the light of a necessary evil. It is not fully automatic in action, or rather it does not automatically accommodate itself to the requirements of the car under certain conditions that are fairly common. For instance, it does not proportion the driving effort of the engine according to the traction obtainable at the driving wheels, and it is for this reason alone that a number of manufacturers of commercial vehicles have equipped their products

Spiral gear differential.

with devices to throw the differential out of action temporarily.

With the device that is shown by the accompanying illustration all the disadvantages of the orthodox type of spur gear differential seem to have been eliminated. It is a new type of differential differing from anything else of its kind. Instead of the usual spur gears, the differential gears are of the spiral type. Because of their shape the action of the mechanism is different from the action of the familiar differential. The master driving gear remains of the bevel type, as may be seen by the picture.

Owing to the shape of the spiral gear teeth, those that are anchored to the housing can be driven but they cannot drive themselves. It follows, therefore, that while the vehicle is moving in a straight line the whole mechanism is virtually locked—insofar as the drive from the engine is concerned—and the axle rotates as a solid one. If one wheel should encounter slippery roadway and lose traction, all the drive then automatically would be taken by the wheel on dry pavement where traction was undisturbed.

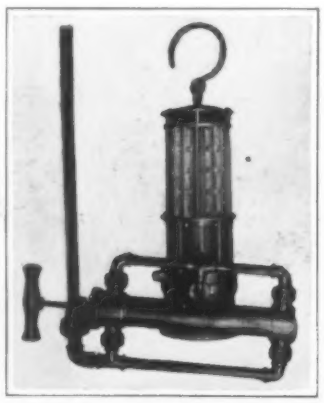
When the vehicle rounds a curve, however, the spiral gears are driven by the road wheels, thus permitting, or rather causing, a differential action similar to the action caused by the ordinary spur gear differential. There is this important difference between the action of the spiral gear differential and the other: The usual type of differential is governed in action by both the distance traveled by the wheels and the traction obtainable by the wheels separately, whereas the spiral gear differential is unaffected by the traction obtainable, and its action is governed solely by the distance traveled by the wheels.

The new gear is the same size as the ordinary type of differential mechanism, for which it can easily be substituted, the operation requiring not more than one hour, where the driving axles are of the full floating type. That it is not more difficult to manufacture than is the ordinary differential is made plain by the fact that six of the spiral gears are identical and are of standard size and shape; two other spiral gears are identical; and the housing is exactly the same as the usual spur gear differential housing. As the two kinds of spiral gears are alike, only two settings of the gear cutting machinery are necessary, whereas each gear in the spur gear differential must be cut separately. Incidentally, for the ordinary 30 horse-power car, it is pointed out by the makers, some 72 gear teeth must be cut for a spur gear, whereas with the spiral mechanism the number is reduced to 54.

Apparatus for Testing Mine Gases

By Frank C. Perkins

A NOVEL apparatus for testing mine gases is shown in the accompanying illustrations. It consists of a small brass pump by which gases are pumped through an extension pipe to a Wolf testing lamp. The percentage of inflammable gas introduced into the combustion chamber of the lamp by means of the pump may be determined by noting the appearance of the tip and the height of the flame. The gas is introduced into the lamp in very small quantities just sufficient to affect the character of the flame without danger of an explosion. With this apparatus it is possible to detect the presence of dangerous gases even when they are not present in sufficient quantities to cause actual explosion. When examining old working places where the roof is badly caved and dangerous it frequently happens that the inspection is not as thorough as it should be because of the danger of entering the chamber. With this apparatus, however, the operator or fire-boss may stand in a place of safety and obtain his sample of the atmosphere by using a long extension tube. A few strokes of the pump will be sufficient to draw a sample of the atmosphere into the safety lamp, into which the gas is forced by the pump. The accompanying illustration shows an operator testing the atmosphere in a chamber thirty feet away, which has been cut off by a fall of rock, but is reached by passing the pipe through chinks in the broken rock wall.



Mine testing apparatus.

Testing the atmosphere in a chamber thirty feet away.

Novel Multiple Drill Head for Roller Bearings

ONE factory has circumvented a troublesome problem in machine design by a special multiple drill head. It was proposed to design a drill head which would drill eleven 0.255 inch roller seats spaced equidistantly on a 1⅛ inch circle. The comparatively large size of the seats on this small circle rendered the spacing of adjacent holes so extremely close that it was considered impractical to drill the eleven seats in one operation and at the same time retain a sufficiently strong spindle construction to make the head practical. With an ordinary multiple drill head the roller cage with eleven holes could not be drilled in two operations, and therefore the head was designed for doing the work in three operations, but working simultaneously on three roller cages. The result of this design is a multiple drill head for attachment to an automatic dial feed drilling machine.

The head is attached to and driven by the automatic drill press having a turret indexing table containing twelve chucking stations evenly spaced on a 9.6-inch circle, in which table twelve cages to be drilled are placed at the same time. The drill head contains three sets of spindles, two having five drills each and the third one drill, located on a radius corresponding to the chucking stations of the indexing turret.

With the turret containing twelve cages the drill head is given its first plunge, drilling five holes in the first cage, five in the second, and one hole in the third. Then the turret is indexed clockwise one twelfth of a revolution, bringing the first cage under the second group of spindles, the second under the third spindle and a new cage under the first group of spindles. Thus, the three operations are carried on successively until one cage is fully drilled, although three cages are operated on at the same time. While these operations are in progress the operator has ample time to remove the completed cages as they come out from under the drills and to insert blanks.

Each of the three sets of spindles is provided with a receding pilot which enters the bore of the cages in advance of the drills and forces them into proper alignment. The receding pilots for the second and third spindles have locating pins which enter the holes already drilled and register accurately the spacing of the holes remaining to be drilled.

An Unusual Type of Tire Inflator

WITH the growing tendency of automobile manufacturers to fit their products out with complete equipment, including a great many devices which at

Power tire inflator.

one time were viewed in the light of "extras" and paid for as such, greater attention is centering upon the necessity for power tire inflators. Of the several that have recently been placed on the market that shown by the accompanying illustration is unique in that it is the first to employ the diaphragm principle so well known in hydraulic pumps.

Needless to point out—for the part sectional picture makes that fact plain—it has no piston nor has it a cylinder, as the word is usually understood. For these reasons the minimum of attention during operation (which means lubrication) is required. As there is no opening between the "crankshaft" if such the eccentric that drives the member attached to the diaphragm may be termed, it is absolutely impossible for oil or oily paper to be discharged into the tire. The air chamber and the crankcase are quite independent in fact, and the former is perfectly sealed by the rubber diaphragm.

Fire Sprinklers—A Correction

IN our issue of September 13th, we published an article on electrical fire protection devices which requires correction. It was stated in that article that "it is estimated that the average cost per sprinkler, including piping valves and sprinklers, is about $30 or $40." This figure is too high. The proper cost of sprinkler work, we are assured, varies between $5 and $8 per head. So, too, the statement that a one hundred thousand dollar factory could be protected only at the expenditure of $20,000 is in error. We are informed that a $100,000 factory could probably be protected for $6,000. These corrections are made because it was our intention in the article referred to, to call attention to the merits of the sprinkler system, which indeed the article did in no uncertain terms.

RECENTLY PATENTED INVENTIONS

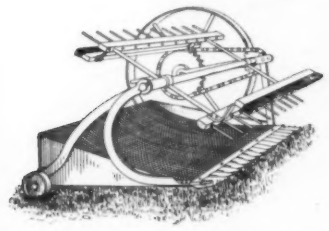
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

SELF-ADJUSTABLE HAT RETAINER.—H. SMITH, Phillipse Place, Yonkers, N. Y. The invention relates to improvements in hat racks and more particularly to a self-adjustable hat retainer for portable hat racks such as are used in hat shops during the process of manufacturing for the purpose of supporting the hats and transporting the same from place to place.

Of Interest to Farmers.

SEED GATHERING ATTACHMENT FOR MOWERS.—Y. M. JACKSON, Laurel Hill, La. This attachment is arranged to have support from the finger bar of the mower, to be adjustable vertically of the latter, a frame mem-



SEED GATHERING ATTACHMENT FOR MOWERS.

ber of the attachment being adapted for mounting on the axle of the mower so that in the adjustment of the finger bar, the attachment will swing with the said axle as a center, there being a beater reel operating over the seed box and driven from the axle.

ORCHARD HEATER.—H. T. LIBBY, Alvin, Tex. This heater prevents injury to fruit trees from cold. It is provided with a number of compartments separated from one another by appropriate means for preventing the undue transmission of heat, the construction thus promoting safety of the apparatus.

Of General Interest.

SHAVING BRUSH.—F. J. MCGUANE, 2959 South Halstead St., Chicago, Ill. This shaving brush has associated therewith a lather rubber relatively firmer than the bristles and centered among them, the rubber being adapted to be brought into action with, and independent of the brush or be moved to inoperative position.

BOOKHOLDER.—W. H. MOREY, 848 Eastern Parkway, Brooklyn, N. Y. This bookholder will hold a book securely in position and at the same time enable the reader to turn the pages without lifting the book out of place. The holder is provided with an adjustable clamping bar, which normally presses against the open pages of the book, but which can be swung out of engagement readily to permit of turning the leaves.

EVAPORATIVE REFRIGERATOR.—G. R. HARRILD, 730 S. Maple St., Spokane, Wash. This improvement has for its purpose the provision of a simple device, wherein the refrigeration is brought about by the forced evaporation of water, which is economical both in construction and operation.

FASTENING FOR HITCHING STRAPS.—P. ROMMES, 318 E. 11th St., Pittsburg, Kan. The object of the invention is to provide an improvement in hitching strap attachments whereby straps may be expeditiously secured around a post or to a ring without tying in the usual manner.

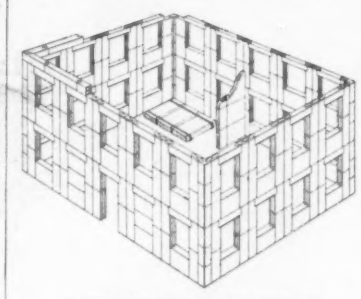
FIREPROOF FILING CASE.—J. A. CLARK, Box 327, Albany, N. Y. The invention provides a new and improved fireproof filing case for filing or housing rolled articles such as maps, charts, drawings and the like. Within an outer cylindrical shell of sheet metal or

FIREPROOF FILING CASE.

other suitable material is arranged, concentrically, another cylindrical shell, an annular space being thus formed between the two shells. By spacing these shells apart an air space is provided which protects the contents of the filing case against heat incident to a fire in the building or room in which the case is stored at the time.

STEAM TRAP.—J. A. BUTCHER, York, Pa. The invention provides a device wherein a special chamber is provided for separating the steam and water prior to their admission to the trap proper, and wherein the water of condensation will be automatically retained at a depth sufficient to prevent the escape of steam, but not high enough to block the inlet.

SECTIONAL CONCRETE BUILDING.—C. ZEIMET, 170 William St., New York, N. Y. This invention has particular reference to a building composed of substantially uniform building blocks made of concrete or the like and adapted to be shipped to any part of the world and there erected with facility, whereby a building of a substantial character may be formed with facility and the building further-

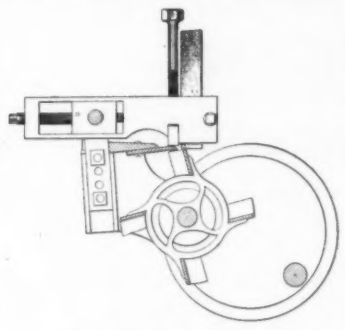


SECTIONAL CONCRETE BUILDING.

more will possess a pleasing character with respect to symmetry and appearance. It may be erected by a party having little or no special skill by following the directions issued.

Hardware and Tools.

LAWN MOWER SHARPENER.—C. E. RING, Bedford City, Va. The invention relates to sharpeners, and has reference more particularly to the class which comprises a support carrying a sharpening stone slidably mounted



LAWN MOWER SHARPENER.

on the lawn mower frame when desired to sharpen the mowing knives. It provides an inexpensive, simple and reliable sharpener by means of which the rotating knives can be properly sharpened with reference to the stationary knife, and in which the sharpening stone is guided by the stationary knife.

Heating and Lighting.

HOT WATER TANK.—F. L. PATTERSON, Brooklyn, N. Y., N. Y. The object here is to provide a tank more especially for use in buildings requiring an ample supply of hot water, and arranged to allow for the expansion and contraction of the steam tubes to insure proper expansion of exhaust or live steam used as the heating medium, and to readily carry off all the water of condensation without danger of such water accumulating or backing up in the steam tubes.

LAMP.—M. COTTON, Clinton, Ind. This invention refers to miners' lamps, and is more particularly intended for use as a miner's lamp burning acetylene gas generated in the lamp. It provides a combination lamp employing, in connection with the main lamp, an auxiliary

MINER'S COMBINATION LAMP.

lamp designed to be temporarily lighted in emergencies, to furnish illumination while adjusting, recharging with carbid or water, or otherwise giving necessary attention to the main lamp.

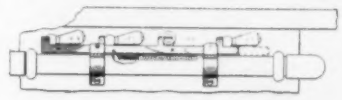
Household Utilities.

WIRE MATTRESS.—O. GASAU, 28 Cumberland St., Brooklyn, N. Y. It is a design of this inventor to provide a form of side guard, characterized in the preferred form by the provision of a novel arrangement of tensioning means, and further characterized by the adaptability of the side guards to be folded below the bottom of the mattress.

TABLE ATTACHMENT.—J. A. MCNAUGHTON, 138 St. Nicholas Ave., Brooklyn, N. Y. In this case the invention refers to table attachments and is more particularly directed to an improved structure adapted to hold vessels or receptacles containing food at different heights from the table.

FRUIT KNIFE.—E. B. LYDICK, 530 Sheridan Ave., Pittsburgh, Pa. This fruit knife or peeler is of use for removing the skin from oranges, lemons or other citrus fruits, and an object of the invention is to provide a knife having means for slitting the skin in sections, means for removing the skin and white pulp, and means for separating the sections of the fruit.

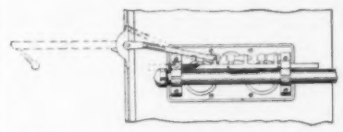
ATTACHMENT FOR GAS STOVES.—C. P. ELLIS, S. W. corner 4th Ave. and Deaderick St., Nashville, Tenn. The principal object of this invention is to provide an attachment for gas stoves comprising a spring-pressed and movable element having parts thereon adapted for engagement with the handles of the



ATTACHMENT FOR GAS STOVES.

valves when in one position and adapted to be moved to a second position, thereby permitting turning of the valves, suitable co-acting means being provided for maintaining the parts in such second position. The illustration shows a side view of the attachment on a stove, the handles of the valves being operable.

SAFETY ATTACHMENT FOR GAS STOVES.—C. P. ELLIS, S. W. corner 4th Ave. and Deaderick St., Nashville, Tenn. The purpose of this inventor is to provide a safety device for use with the gas cocks and oven of a gas stove, making it practically impos-



SAFETY ATTACHMENT FOR GAS STOVES.

sible to turn on the gas without first opening the door of the oven and furthermore preventing the closing of the said door without either shutting off the supply of gas or waiting until the temperature of the oven has reached a certain degree, thereby tending to prevent the inadvertent escape of gas with consequent fatal results. The engraving shows a vertical side view of the gas stove.

Machines and Mechanical Devices.

CUTTER HEAD.—GEORGE A. ENSIGN, care Defiance Machine Works, Defiance, Ohio. The aim of this inventor is to provide a cutter head provided with adjustable bit or blade holders, arranged to prevent marring or bruising the head by clamping screws, or as the result of removed clamping screws. To accomplish the desired result, use is made of a hub provided on its peripheral face with a series of undercut grooves extending parallel to the axis of the hub, the bit holders having bases slidingly engaging the clamping members of a base to draw the clamping members into clamping contact with the walls of the groove.

CONTROLLING VALVE.—S. S. SMITH, 108 Cottage Drive, Covina, Cal. This valve is for use in air-brake equipments, for controlling the distribution of the air from the train pipe and signal pipe to the triple valve, by means of which the triple valve and brake mechanism of any car may be connected with the atmosphere, while retaining a connection between the train pipe and the auxiliary reservoir.

PHOTOGRAPHING APPARATUS.—J. BRIELOFF, 168 Delancey St., New York, N. Y. This apparatus is designed particularly for taking pictures upon postal cards and similar articles and is furnished with a magazine wherein a number of cards may be placed. Mechanism is provided for moving the cards suitably sensitized, into and out of position with respect to the lens.

MACHINE FOR FORMING AND INDENTING ROLLS OF DOUGH.—H. SIEGL, Vienna and J. Engel, Felixdorf, Austria-Hungary, P. O. addresses, respectively, 25 Deinhardtsteingasse, Sixteenth District, and Felixdorf. In the attempts that have been made to effect the difficult and lengthy manual operations for forming channels or otherwise indenting rolls of dough as completely and effectually by mechanical means, the defect is remedied by the present invention, wherein an indenting device comprising a series of blades displaceable upward and downward and mounted between the roll-forming blades is provided which co-operates with the latter, the blade of said device being curved to correspond with said forming blades. The baking operation proceeds in the same manner as with hand-made rolls, and the taste is the same.

BOBBIN AND SPINDLE CONNECTOR.—C. NORDELL, Gilbertville, Mass. The invention provides an improved form of spindle and bobbin connector for a spinning frame. Centrifugal force is depended upon to form a friction connection between the revolving shaft and the bobbin.

SMOKE AND FUME RECORDER.—W. W. STRONG, Mechanicsburg, Pa. This invention relates to an apparatus for recording the presence of smoke or fumes and the principal object is to furnish a simple, cheap, and effective mechanism suited to the purpose which will afford a construction superior to such devices heretofore employed.

THROTTLING DEVICE.—E. E. MCCAULEY, Taft, Cal. The invention provides a device which will be automatically actuated in case the oil well becomes clogged by sand, causing the pumping mechanism therein to stop, or in case any of the parts connected to the pumping mechanism should happen to break, to cause the controlling valve of the engine operating the pump to shut off the supply of motive agent thereto and stop the machinery immediately before further damage can result.

COTTON HULLER, CLEANER, AND FEEDER.—J. F. WOLFINGER, Boynton, Okla. In order to provide an inexpensive cotton huller, cleaner and feeder, which will efficiently and rapidly separate the hulls and foreign substances from cotton so that the cotton is clean when entering the mill, Mr. Wolfinger has invented a machine applying a plurality of driven cylinders provided with feeding and disintegrating means, all supported and inclosed in a proper casing.

Railways and Their Accessories.

RAIL JOINT FOR PORTABLE TRACKS.—P. J. THULL, Culebra, Canal Zone. Where mechanical shovels, excavators, cranes, or other similar machines are used for construction purposes, tracks formed of short length are generally provided for the displacement of these machines as work progresses, and in consequence the tracks are made movable and portable, as during work side displacements are very necessary. To avoid many difficulties that arise in construction purposes the invention eliminates to a great extent the disadvantages, and can be easily used for both vertical and horizontal curvatures, and the means associated with the rail joint eliminate horizontal displacement while keeping the vertical displacement.

DRAFT RIGGING.—G. B. MORSBERGER, 1427 Hanover St., Baltimore, Md. This invention comprehends a draw-bar so arranged that when in normal or inactive position it is subjected to the tension of a spring, and when in active use for pulling cars the tension upon the spring is increased, and when the pull upon the draw-bar is excessive a portion of the strain is thrown upon additional or reserve springs.

Pertaining to Vehicles.

WHEEL.—S. BROWN, 40 Whitecross St., London, England. An object of the inventor is to provide a resilient spring wheel for use on vehicles, whereby may be obtained all the advantages of a pneumatic or cushion type wheel without the disadvantages thereof. The wheel absorbs shocks from uneven roads, or obstructions on the same, and the wheel is stiffened and reinforced sufficiently to exclude dust from the movable parts.

ENGINE STARTER.—G. J. SPOHRER, care of Wilson Motor Starter Co., Franklin, Pa. The invention pertains to a form of engine starter more especially adapted for use on road vehicles, particularly to that class of vehicles driven by internal combustion engines where it is necessary to start the sparking mechanism by "turning over" the engine shaft, forming an improvement on construction outlined in a former patent granted to Mr. Spohrer.

Designs.

DESIGN FOR A SAVINGS BANK AND STAND.—C. DE YOOS, 520 53rd St., Brooklyn, N. Y. This design comprises a bank shaped to resemble a league baseball, the slot to receive money being placed at the top. An ornamental stand holds the bank placed in the center of the square.

DESIGN FOR A SUPPORT FOR DISPLAY RACKS.—J. SPIELES, 462 W. Broadway, N. Y., N. Y. In this ornamental design the support has four feet and is of an elevated, irregular but highly graceful form.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

How the Government Tests Paper

(Concluded from page 260.)

cure sufficient and representative samples, for slight differences in materials and processes of manufacture may affect the general run.

The next test is to determine the thickness of the sheets or the bulk. With limited space in both public and private libraries a demand has arisen for less bulky books, and consequently thinner paper, and to-day it is considered the best practice to employ a paper of better quality of material, but of less bulk. The roughest test for thickness is to take or fold together a certain known number of sheets and then measure their thickness with a rule or more usually with a caliper rule. Increased accuracy is secured by the use of some form of calipers for the single sheets, while for the most refined measurements a micrometer gage that may be read to 1/1,000 or better 1/10,000 of an inch is employed. This is an ordinary form of screw micrometer, but care must be taken to secure an even and constant pressure, and the average of a number of readings, at least five, should be taken. There are also direct-reading micrometer thickness testers, and one of these used at the Bureau of Standards is shown.

Ascertaining the Strength of a Sample.

Strength is the next important consideration, and is one of the more usual commercial tests to which paper is subjected. In the ordinary American strength tester, usually the Mullen type, a sample of paper is clamped about a circular opening one square inch in area, below which there is a rubber diaphragm. By means of a hand wheel the pressure of a liquid on the diaphragm is increased until the paper is ruptured, the number of pounds pressure being indicated by an accurately calibrated gage. The bursting pressure, the average of ten readings, is assumed to represent the mean strength or the average of the strength across and lengthwise of the sheet, but this is not strictly true as it corresponds more closely with the mean strength or the strength in the cross direction. With this machine the application of the pressure by the manipulation of the wheel and other conditions can effect the readings, so that the same paper will not give uniform tests.

It is also desirable to ascertain the tensile or breaking strength as well as the bursting strength, and for this use is made of a German machine, the Schopper strip tester, in which the weight required to break a strip of known width and length is automatically recorded and the amount of stretch before rupture. This test is the approved one in Europe for strength, and in recent United States specifications tests with the Schopper machine are specified, though a corresponding test on the Mullen machine is given for the benefit of manufacturers not supplied with the German apparatus. A strip 15 millimeters in width and 180 millimeters long is taken, which is clamped at either end and the tension is applied with a piston and cylinder. In this test strips both with and against the grain of the paper are used and information is gained by the two sets of tests as to the structure of the paper. The German method is to state the strength of a given sample in terms of the length required to break it when suspended by one of its ends.

The test for endurance comes in measuring resistance to folding, which test takes the place of the former rough crumpling test where a square sample of the paper was taken, crumpled up in the hand, smoothed out, and then crumpled in the opposite direction, repeating the process and observing the number of minute holes formed along the creases. The folding test is very important as determining the durability as the greatest wear comes where a sheet is folded in binding in a book or pamphlet or in the case of a map, bond, or legal document, that must be folded and unfolded frequently. The crude method of crumpling has been supplanted by the folding machine, which is also of German origin, and it affords ac-

curate and quantitative results. By many authorities it is considered the most valuable single test to apply to paper to determine its probable durability in actual service. In the Schopper folder a strip 15 millimeters wide and 95 millimeters in length under a standard tension of 1,000 grammes is bent back and forth repeatedly on itself, until the fibers wear through at the line of folding, and the number of double folds automatically is registered. The paper of the greatest endurance has the highest "folding number." For example in an extreme case the Government specifications for the "best parchment deed" paper require that it shall have a folding endurance in the weak direction of not less than 2,000 double folds.

The Influence of the Atmosphere.

The expansion of paper under various atmospheric conditions is important in many printing operations, and this is tested by measuring the sheet as temperature and humidity are varied. Then there is the measure of the amount of absorption, which is determined by the height that a liquid will rise by capillary action in a given time when a strip is suspended vertically with the lower end immersed in water. Such a test is of course peculiarly applicable to blotting paper. All physical tests of paper must be carried on at a standard temperature and humidity, which, at the Bureau of Standards, is taken at the average temperature of 65 deg. F. and 65 p. c. of relative humidity, the elaborate heating and ventilating system of the bureau permitting the realization and control of these conditions. The transparency of paper may be decided by the number of sheets which must be interposed between a standard source of light such as a 1-candlepower Heffner amyl acetate burner and an observing telescope to cut off the light. This, however, though useful in the case of tracing papers, window envelops, etc., is a test of limited value.

The testing of paper by no means ends with the physical examination. Under the microscope the kind or kinds of fibers from which a sample of paper is made readily can be identified, not merely the long fibered materials such as cotton, flax and hemp, which afford the most durable papers as they yield a nearly pure cellulose, but others which have been subjected to extensive chemical treatment. At the Bureau of Standards microscopical examination is able to indicate the correct fiber contents of a sample within 5 per cent in the case of a mixture of rag and bleached chemical wood, while in the case of papers formed by combinations of sulphite and soda pulp and containing ground wood a degree of accuracy well within 10 per cent has been secured. A special techinque involving the treatment and staining of the fibers has been developed so that they readily are recognized and their relative proportions estimated.

Analyzing "Loaded" Papers.

Chemical analysis is necessary to determine the amount of loading or white insoluble mineral matter added to paper during manufacture to improve printing qualities, increase opacity and reduce weight. In the coated papers used for fine half-tone printing this material may amount to 30 per cent or more, while in other papers it varies from a minimum of 0.5 per cent. While essential to detail in fine half-tone printing it weakens the paper and decreases its durability. This loading is determined by the amount of ash, the permissible amount of which is stated in paper specifications. It is ascertained by burning a small sample of paper in a platinum crucible until there is no carbon in the residue, which is then cooled in a desiccator and weighed, being subjected to analysis in cases it is desired to know the kind of loading material used. The amount of ash thus obtained is really less than the actual amount of loading or filler, which may contain water and other volatile agents that pass off in the burning. Chemical analysis also reveals the nature and amount of the size used to render the surface of the

paper suitable for printing or receiving the ink. These may consist of glue, casein, starch or rosin, and when used in undue amounts may affect the strength and durability of the paper. The analysis will also indicate the nature of the coloring matter used.

Paper testing and analysis are also extensively carried on in private and commercial laboratories with which the Bureau of Standards in no way seeks to compete. In paper as in other industries, its services have not been confined to the National Government, but it has sought to improve and advance manufacturing and trade conditions by the formulation of proper standards and technical research. In this, the paper testing laboratory in charge of Mr. Frederick C. Clark, to whom the author of the present article is under obligations for information and photographs furnished, has been eminently successful.

Recent Improvements in the Refrigerating Industry

(Concluded from page 261.)

is in the form of a liquid as when in the gaseous condition. In this condenser the hot gas entering at the bottom comes in contact with the cooled liquid, gives up its heat to the liquid and becomes condensed. The liquid thus heated rises to the upper part of the condenser where its heat is transferred to the cooling water. When in operation the condenser is practically full of the liquefied refrigerant. Of course there is always a constant flow of liquid to the expansion coil from some point in the condenser above the gas inlet.

Important changes have also been made in the expansion or evaporating devices, but these changes involve the method of operation rather than the structure. Until recently the general practice was to permit the high pressure liquid refrigerant to pass into the expansion coil through an expansion or throttling valve in the form of a spray. As it passed through the evaporator this spray was gradually converted into a gas by the heat absorbed from the substance to be cooled, and the gas was constantly sucked out by the compressor and recompressed. It was found, however, that by maintaining the evaporator partially filled with liquid refrigerant the cooling was much more uniform and satisfactory.

In Fig. 4 is shown a section of a shell brine cooler of the flooded type in which the brine to be cooled is forced through the tubes by a pump. The shell is maintained practically full of liquid ammonia, the inflow being governed by a float valve as shown. The ammonia vapor produced by the heat of the brine is constantly drawn off at the top by the compressor. In construction and operation it is not unlike a steam boiler. The heat, however, is obtained from the brine flowing through the tubes instead of from combustion gases. About one tenth of the liquid ammonia flashes into vapor as it enters the cooler by reason of the reduction of pressure. In the flooded type of cooler this vapor does not pass through the cooler but is led direct to the suction pipe, as shown in the illustration.

In the absorption refrigerating field but few changes have been introduced except attempts to make such machines automatic so that they can be used for household purposes. The recent discovery that certain solids, particularly sulpho-cyanid of ammonium, could be used as the absorbent in place of water, attracted much attention. This absorbent gave very flattering results as to heat efficiency, but proved to be extremely corrosive, destroying the walls of the generator in a comparatively short time. Should this difficulty be overcome, the absorption machine may come into more general use.

Probably the most extensive use made of artificial refrigeration is in the manufacture of ice, for except in the most northerly States, manufactured ice has largely replaced the natural product. The crop of natural ice is often uncertain, both in quantity and quality, and the cost of

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.

MUNN & CO., INC.

Inquiry No. 9321. Want name and address of a firm who could make a machine for turning out rat buttons. The machine must be capable of making the dough of the exact size required, and also a machine to manufacture the tins and a machine for placing the dough in the tins. Preferably this machine should do all of this work in one operation.

Inquiry No. 9324. Wanted—prices including discounts and full particulars of reliable and inexpensive voiturettes or motor cars for export.

Inquiry No. 9325. Wanted the name and address of some stamping concern in New England who could manufacture a window shade bracket, the materials to be used being 14, 16 and 18" gauge.

Inquiry No. 9326. Wanted to communicate with those having inventive ability with a view of acquiring or assisting in developing an invention for mail order use.

Inquiry No. 9327. Wanted to get in touch with a patentee of some article requiring a small amount of capital and selling ability.

Inquiry No. 9328. Wanted, names and addresses of manufacturers of curtain poles and curtain pole brackets or extenders; also manufacturers of window shades.

Inquiry No. 9329. Wanted, names and addresses of patentees of useful household utilities preferably for use in the home laundry or kitchen. This inquirer wishes to correspond with a view of purchasing patents outright.

storage and transportation is an important item.

In the Southern States and in the tropics the only ice available is that which comes from the local ice plant, and practically all such ice is made either by the can or plate process. In the former the cans of water are set in a tank filled with brine which is cooled by the ammonia. The ammonia coils are usually arranged between the rows of cans, but a shell cooler, such as is shown in Fig. 4, may be employed, and the brine is circulated through the shell and thence around the cans. The brine is cooled by the ammonia and this cold brine around the cans causes the water therein to freeze. The brine acts merely as a heat or cold transferring medium, and in addition serves as a large reserve of cold in case the compressor should be stopped for any reason. Common salt and calcium chloride are used for making the brine. When all the water in a can is frozen the can is drawn out and warm water is poured over the outside until the cake is loosened and slides out, after which the can is refilled and replaced in the cold brine. In the plate process a series of freezing plates are arranged side by side in a tank filled with water and the ice forms in large cakes on the sides of the plates. The water is kept in constant circulation through the tank in order that the ice may be clear. Each freezing plate is made up of a large number of connected pipes arranged one above the other, through which the refrigerant circulates. To freeze a cake a foot thick requires about a week. In removing the cake a warm fluid is circulated through the plate until the ice is loosened and it is then lifted out and cut into pieces of convenient size.

In the ice manufacturing industry the most marked improvement has been the development of the raw water system. Should cans filled with raw water or ordinary city water be frozen without any agitation, the ice will be white or opaque, due to air bubbles and sediment frozen in the ice, and for this reason distilled water was heretofore universally used in making can ice. However, by injecting a constant stream of air into the raw water during the freezing, ice can be obtained as clear and pure as with distilled water. To distill all the water used in a can plant is an item of some expense, and especially so where other power than a steam engine is used. Fig. 5 shows one of the latest forms of the freezing can. The air is injected through the bottom of the can, which is not exposed to the cold brine. Pipes for circulating water through the can are also provided. The cans are secured in the tank and to harvest the ice the brine is warmed sufficiently to loosen the cake.

Important improvements have also been made in the freezing plates of plate ice systems. In the older forms the ice cake was frozen on one side of the freezing plate, and as the transmission of heat through the ice is very slow, it required a number of days to freeze a cake of marketable thickness. With the apparatus shown in Fig. 6, the time of freezing can be very greatly reduced. This device consists of a row of outer tubes closed at the top, projecting up into the tank and inclosing inner tubes open at the top. These tubes are connected with supply and return headers for the refrigerant which may be brine or liquid ammonia. In operation, the ice gradually increases in thickness around these tubes until the various masses meet and coalesce to form a continuous cake. This cake is harvested by circulating a thawing fluid in lieu of the refrigerant, and when loose, the cake is lifted out and cut up into convenient sizes.

In the field of cold storage probably the most important improvement has been made in the method of transporting fruit and vegetables. It is now generally recognized that by precooling these substances before shipment, they reach their destination in far better condition and much less ice is used in transit than with the old method. In recent years many large plants have been erected at important

fruit and vegetable shipping points for cooling the cars after loading. These plants in the main consist of apparatus for cooling air in large volumes, and this cold air is conducted by air mains to the various cars to be cooled.

Another new field in which refrigeration is extensively used is the drying of air for blast furnaces. Fig. 7 shows one of the latest forms of cooling towers for this purpose. It consists of a concrete tank on which is erected several concentric metal shells. The air to be cooled enters at the base of the outer shell and ascends to the top through a heavy spray of cold water. The air then goes down through an annular passage to the bottom of the inner shell and ascends through a shower of cold brine and is then drawn off through the central pipe to the blowing engine. In the tank are located refrigerating coils for cooling the brine which is pumped to the top of the tower and used over and over again. As the brine becomes diluted in time by the water vapor condensed out of the air being treated, it must be drawn off from time to time and concentrated by boiling. In this direct contact method there is no accumulation of frost in any part of the machine, and the cooling is much more rapid than with refrigerated surfaces. For these reasons this method is now generally employed for cooling large volumes of air.

The Newspaper of the Future

By Robert Donald

IF I were to attempt to forecast the future, and prophesy what newspapers of twenty or more years hence are likely to be, I would say with some confidence that daily newspapers will be fewer, the tendency toward combinations will increase, and colossal circulations will continue to grow. A paper which has not at least a half-million readers will not be considered seriously as an organ of the people. The weak newspapers which cannot spend huge sums on news, on features, and on circulation, will, of course be squeezed out, and the paper run as a luxury or for a mission, and not as a business enterprise, will become too expensive except for millionaire idealists. There will, therefore, be fewer newspapers, but the total circulation will be greater. The power of these national journalistic dreadnoughts in molding and influencing public opinion will not be less, in whatever direction their influence is exercised. Besides the national newspapers, giving an epitome of life, and presenting the human and picturesque side of news collected from all parts of the kingdom and all ends of the earth, there will be localized newspapers which will follow the method of the national press in presenting news. There will, I hope, be a revival of the purely local country newspapers, much improved in form and style, otherwise public life will suffer a serious loss. The more national newspapers become the less space will they give to sectional interests, and we shall have specialized daily newspapers to take the place of the specialized weeklies which now exist.

The national newspapers will not contain less reading matter, but the pages will be smaller. They will be printed better and neatly stitched, and will, of course, include pictures in color. The future methods of distribution will be quicker, and circulations will cover greater areas. Airships and aeroplanes will be used for the most distant centers; electric trains and motorplanes, running in special tracks, will also be used. In all the chief centers of population papers will be distributed by electric or pneumatic tubes. The morning and evening newspapers will be merged, and editions will come out almost every hour, day and night.

News will be collected by wireless telephones, and the reporter will always have a portable telephone with him, with which he can communicate with his paper without the trouble of going to a telephone office, or writing out a message. At the other end the wireless telephone message will be delivered to the sub-editor printed in column form.

The chief competition to the national

newspapers of the future will not be from other newspapers, but from other methods of disseminating news.

At the people's recreation halls, with the cinematograph and the gramophone, or some more agreeable instrument of mechanical speech, all the news of the day will be given hot from its source. People may become too lazy to read, and news will be laid onto the house or office just as gas and water are now. The occupiers will listen to an account of the news of the day read to them by much improved phonographs while sitting in their garden, or a householder will have his daily newspaper printed in column form by a printing machine in his hall, just as we have tape machines in offices now.—*Abstracted from a presidential address delivered before the annual conference of the Institute of Journalists, York, England.*

India Paper and Its Uses

By Willard F. Smith

ONE of the oldest and best papers made is that called india paper, and yet it is little known except to a very few. The formula for making it and the process by which it was made were for many years a secret known only to one mill, and all efforts to produce a similar paper in other mills were failures. However, patient endeavor was at last rewarded. Now good india paper is to be had from at least two different mills in England, one in Italy and one in the United States, and it is interesting to note that the American mill to solve the india paper problem in 1912 was the first mill in the United States to make wood pulp paper, which it did in the year 1854.

The essential requisites of india paper are opacity, light weight, low bulk, smooth finish, strength, and a certain rattle called "tinniness." To embody all these characteristics simultaneously is one of the most difficult tasks in paper manufacture.

Opacity is the first thing users of india paper look for. If the printing shows through, the paper is of no use. Even with the most opaque sheet in light weight the utmost care is required on the part of the printer. His make-ready must be perfect; every line and border must be in register with the opposite side of the page. The utmost care must be exercised in printing. A dry ink is sure to give the best results. This does not mean that the average first-class printing establishment cannot do the work; for it can. It simply means that care must be given in making ready. The writer was recently informed of a printing job, in which sixteen hundred impressions per minute were run with great success, proving that production is not restricted by the use of lightweight papers.

India paper must be kept for several days by the printer in a room where the temperature and humidity are approximately, if not quite, the same as in the printing room, and, better yet, if kept in the actual room where it is to be printed. This will overcome curling or "cockle," as it is known to the trade.

Attention must next be given to the grain of the sheet, which is in the same direction as the length of the paper, while being made on the paper machine. The fibers when run on the machine in many times their volume of water naturally run out lengthwise and a sheet has more strength and resistance in that direction than the other; but it is evident that the fibers will separate one from the other more easily than they will break. It is this characteristic which first makes it necessary to feed the paper across its grain to the printing press. This also brings the binding the same way as the length of the fiber, which makes a smooth flat book. The results when the sheet is printed "with the grain" the other way is to draw it into wrinkles as does a linen sheet when put through a wringer.

The use of india paper until within a few years was limited almost exclusively to Bibles, prayer books and hymnals. Of late each year finds some publisher using it for new purposes and always with great

success. Now we find it used in printing the works of our standard authors and poets, the latest issue of our prominent dictionaries and encyclopædias, current literature, advertising matter, and mail order catalogues. One progressive advertiser changed from the heavy catalogue paper used many years in his annual catalogue to an inexpensive form of india paper and saved over $20,000 on the issue, the principal item being seven cents in postage for each catalogue. A good illustration of the saving in bulk and weight over the paper heretofore used is found in the new edition of Webster's dictionary. The old dictionary measures 8½ inches by 11½ inches, has 1,766 pages, and weighs 9 pounds 11 ounces. The new edition, printed on india paper, is size 9 by 12, has 2,624 pages and weighs 6 pounds 13 ounces. The old edition is four inches thick and the new edition two and a quarter inches thick. From this it is seen that a book with pages of approximately the same size, the number of pages has been increased about 850, the thickness reduced one and three fourth inches and the weight reduced nearly three pounds.

In addition to the advantage of small bulk and light weight, both of which are so important, india paper has a wonderfully soft, smooth surface. It takes line cuts, steel engravings and zinc etchings perfectly and very good half-tones. It has one more quality which is really remarkable, and that is it does not suffer from rough usage as one might think; it stands up under hard wear, and if badly crumpled by any mischance it can be smoothed with a heated iron and made as good as new.

A New Mail Carrying Railway

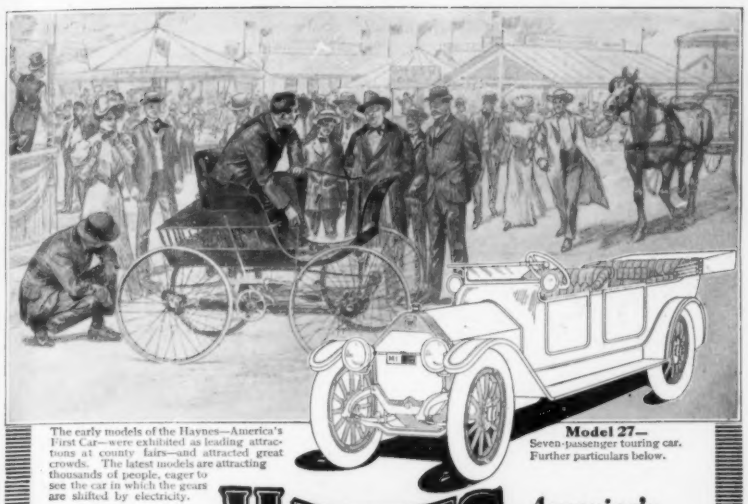
(Concluded from page 268.)

being transmitted without physical contacts through pilot coils imbedded in the track member leading to the operator's office.

When descending a grade, power is regenerated back into the line, the conserved energy serving better than a physical brake in keeping the cars close to synchronous speed.

This system has certain advantages over miniature electric railways without motormen, which must be perfectly obvious. The same unit of power will send a car farther and faster when applied as a direct push or pull than when exerted indirectly through gearings, bearings, axles and wheels in the form of wheel traction. In lieu of the motor, its accessories and housing, the cars carry only a light propelling member, which being placed beneath the car leaves the entire car space free for freight, thus effecting a saving in weight, care and cost, and increasing the carrying capacity. Instead of being limited to moderate grades, the cars may be designed to take any grade, enabling the delivery and dispatch of mails from terminals located in second story distributing rooms of post offices, as in the New York Central terminal station, thus obviating the cost, delay and inconvenience of rehandling, as well as the lifting and lowering by elevators.

As each wheel turns independently of the others, resistance is reduced and the grinding on grades, caused by the rigidly connected wheels of wheel traction systems, is eliminated. The speed of the cars, not being dependent upon the tractive effort or revolutions of necessarily small wheels, is limited only by mechanical laws and strength of construction. Instead of the irregular and disconnected behavior of motor-driven cars, which render operation under close headway hazardous, all cars moving in synchronism, like buckets on a belt, must move uniformly over successive sections of track, thus rendering the system immune from collisions while endowing it with a far greater carrying capacity than can be expected of systems which require block systems and minutes of headway between cars. Clearly, a system which allows the dispatch of cars every five seconds has twelve times the capacity of systems which require at least sixty seconds between cars.



The early models of the Haynes—America's First Car—were exhibited as leading attractions at county fairs—and attracted great crowds. The latest models are attracting thousands of people, eager to see the car in which the gears are shifted by electricity.

Model 27—Seven-passenger touring car. Further particulars below.

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Vulcan Electric Gear Shift is standard Haynes equipment

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Model 28, 4 cyl., 48 Dynamometer H.P., 118-in. wheelbase, 2 pass. roadster, 4 or 5 pass. touring $1985; coupe $2700.

Model 26, 6 cyl., 65 Dynamometer H. P., 130-in. wheelbase, 2 pass. roadster, 4 or 5 pass. touring $2700; coupe $3200.

Hand lever optional, all models, at $200 reduction.

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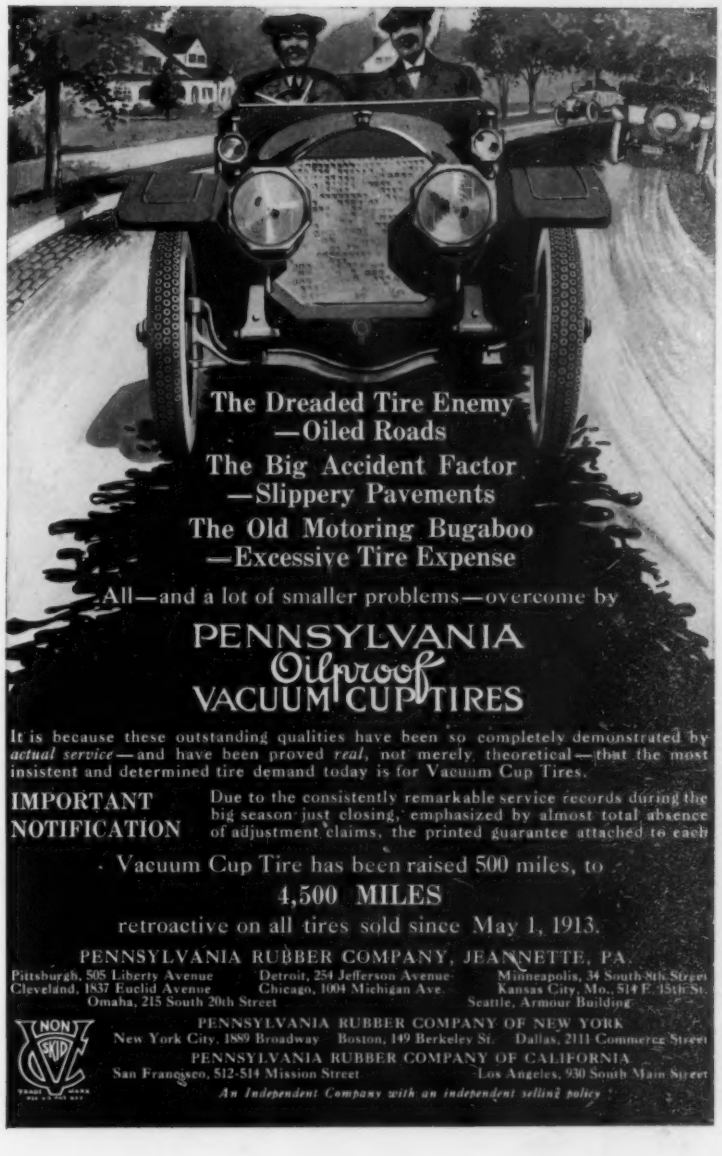

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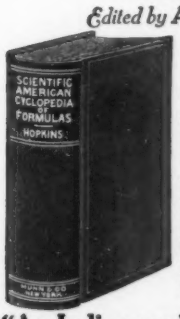

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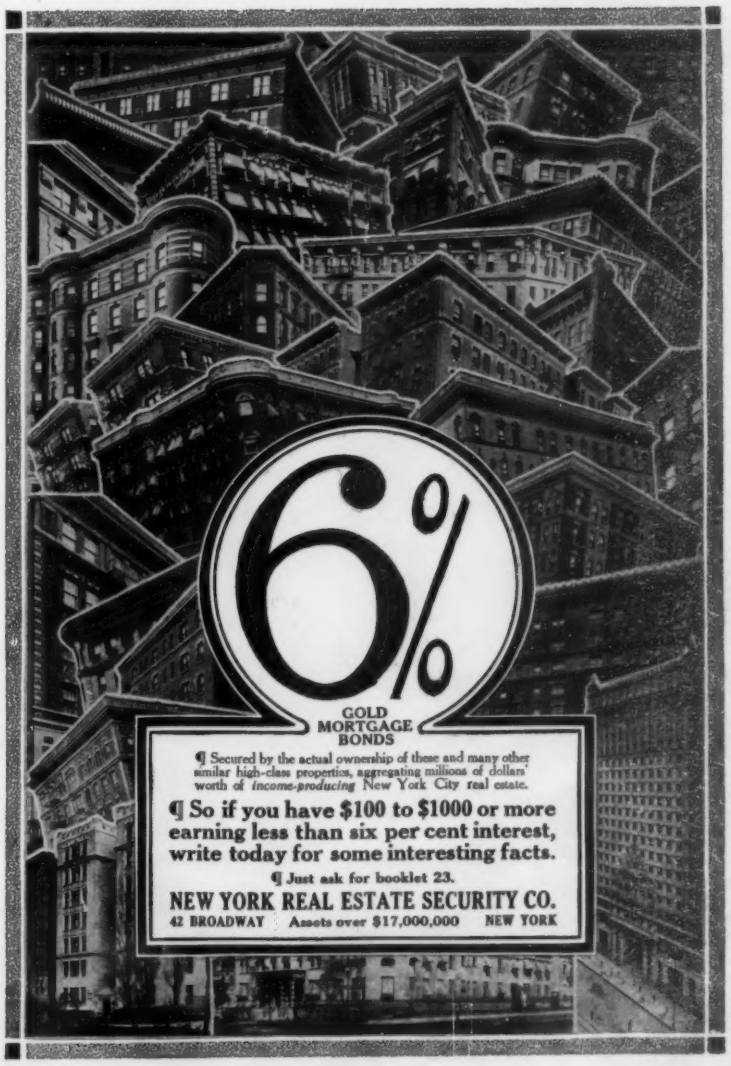

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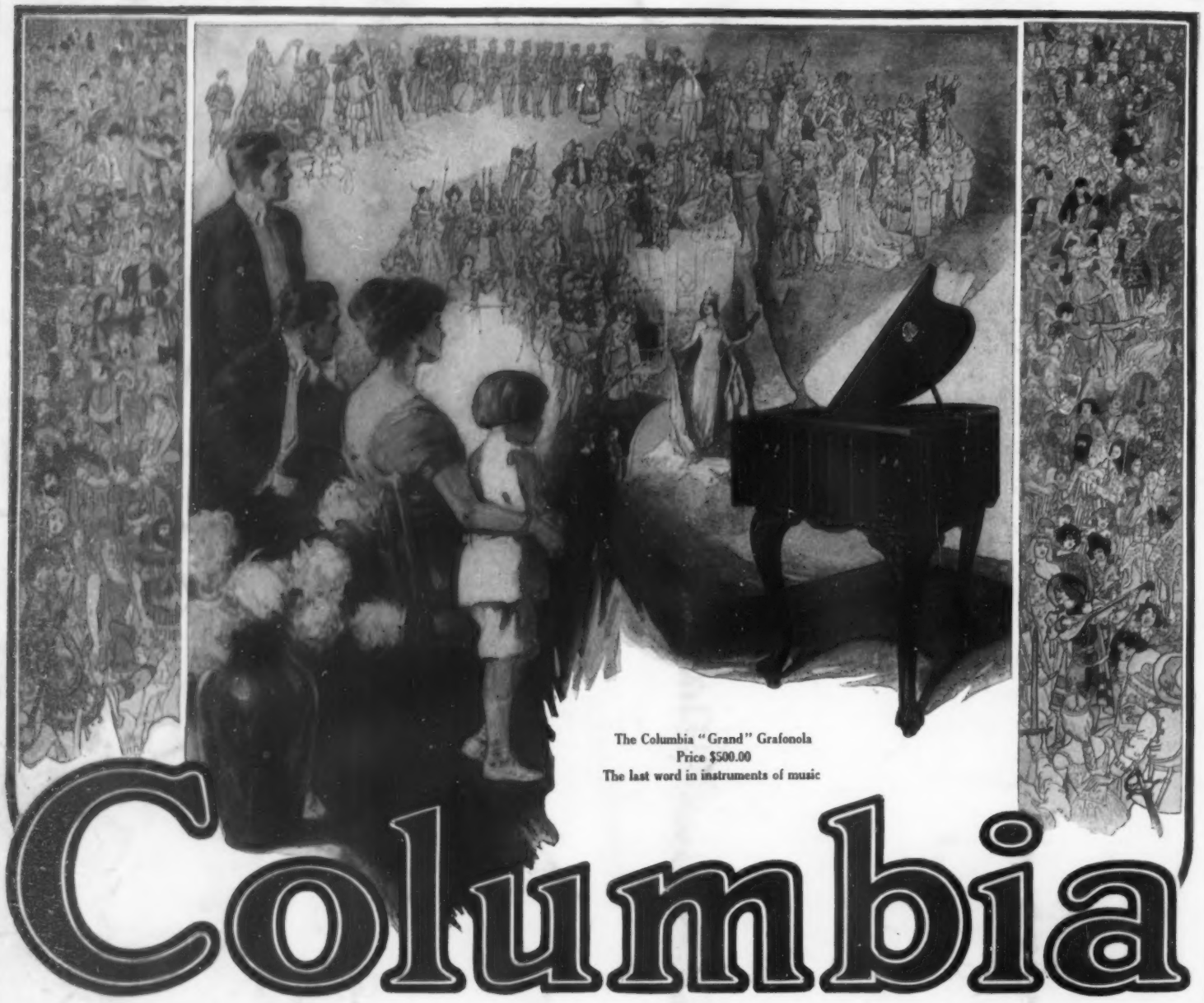

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